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# Quasi-Static Aero-Thermo-Elastic Analysis: Analytical Development and Computational Procedure

1 MARCH 1963

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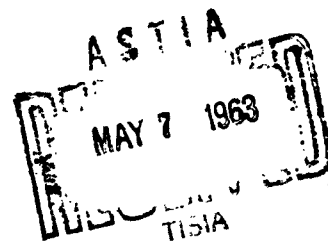
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UNITED STATES AIR FORCE

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ANALYSIS: ANALYTICAL DEVELOPMENT  
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## ABSTRACT

A collocation formulation is used as the basis for a unified approach to the various quasi-static aero-thermo-elastic problems. These problems include rigid and flexible load distributions, divergence, estimation of rigid and flexible static and dynamic stability derivatives, and the correction of wind tunnel data measured on flexible models. The formulation utilizes structural, thermal, and aerodynamic influence coefficients.

The Aerospace IBM 7090 Computer Program No. LD003A provides the solution to the above problems. The program capacity is fifty collocation control points and ten values of dynamic pressure.

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## SYMBOLS

$a$	Element of flexibility matrix
$a_T$	Element of thermal influence coefficient matrix
$b_r$	Reference semichord
$C_h$	Element of oscillatory aerodynamic influence coefficient matrix
$C_{hs}$	Element of steady aerodynamic influence coefficient matrix
$C_l$	Aerodynamic rolling moment coefficient
$C_m$	Aerodynamic pitching moment coefficient
$C_z$	Aerodynamic normal force coefficient
$C_z$	Element of aerodynamic normal force coefficient distribution matrix
$C_z^{(e)}$	Element of experimentally determined aerodynamic normal force coefficient distribution matrix
$c$	Local chord
$\bar{c}$	Mean aerodynamic chord
$\tilde{c}$	Average chord
$c_l$	Local spanwise lift coefficient
$F$	Element of force matrix
$H$	Generalized reference deflection
$H_o$	Reference deflection for initial deflection mode
$h$	Element of deflection matrix
$I$	Element of unit matrix
$K$	Flexibility matrix normalizing constant
$k_r$	Reference reduced frequency

$\mathcal{L}$	Rolling moment
$M$	Element of mass matrix; bending moment
$\mathcal{M}$	Pitching moment
$N$	Reference load factor
$n$	Element of load factor matrix
$q$	Dynamic pressure
$q_{div}$	Divergence dynamic pressure
$S$	Surface reference area
$s$	Surface span measured from root to tip
$T$	Reference temperature; torque
$t$	Element of temperature distribution matrix
$V$	Shear
$W$	Element of aerodynamic weighting matrix
$x, y$	Cartesian coordinates
$\bar{x}, \bar{y}$	Coordinates of aerodynamic center
$x_o$	Coordinate of pitching moment reference axis
$Z$	Normal force
$\Delta( )$	Denotes incremental value
$\theta$	Angle of pitch
$\lambda$	Eigenvalue
$\xi$	Control point location as fraction of local chord
$\rho$	Atmospheric density
$\omega$	Frequency

### Subscripts

a	Aerodynamic
f	Flexible
H, T, N	As subscript to $C_Z$ , $C_m$ , and $C_l$ , denotes partial differentiation with respect to H, T, or N, respectively, e. g., $C_{ZH} = \partial C_Z / \partial H$ ; as subscript to $C_Z$ , merely denotes reference to H, T, or N
i	Inertial; also used as dummy index, e. g., $\Delta y_i$ denotes width of <u>ith</u> strip
m	Model; moment
o	Initial value
r	Rigid

### Matrices

[ ]	Square
{ }	Column
[ ]	Row
[ ] <sup>-1</sup>	Inverse
[ ]	Diagonal

## SECTION I

### FORMULATION OF PROBLEM

#### A. Introduction

The most general numerical formulation that can be made of the various aeroelastic problems is a collocation formulation expressed in terms of matrices of structural, inertial, and aerodynamic influence coefficients. Such a formulation of the flutter problem has been discussed in Ref. 1, and of the static aeroelastic problems in Ref. 2. The present report reconsiders the static aeroelastic problems by reviewing the derivations and extending the computational procedures of Ref. 2 in treating the problems of rigid and flexible load distributions, divergence, estimation of rigid and flexible static and dynamic stability derivatives, and correction of wind tunnel data measured on flexible models.

The basis for the present generalized aero-thermo-elastic analysis is found in recent advances in both aerodynamic and structural theories. The aerodynamic developments have proffered aerodynamic influence coefficients based on a number of theories, covering the entire Mach number range of current interest. The structural developments have provided structural and thermal influence coefficients for external and temperature loadings, respectively, for surfaces of arbitrary aspect ratio. The current state of the art of aerodynamic and structural influence coefficient analyses is surveyed in Refs. 3 and 4, respectively.

#### B. Sign Convention

We choose the NASA body stability axis system as our coordinate system: x forward, y starboard, and z down. Positive loads and deflections are in the same directions, and positive moments are given by applying the right-hand rule to the coordinate directions.

### C. Derivation of Equations

The force distribution  $\{F\}$  acting on a flexible lifting surface or body arises from two sources: the aerodynamic forces resulting from the attitude (as specified by the deflection mode  $\{h\}$ ), and the inertial forces resulting from a distribution of load factor  $\{n\}$ . The aerodynamic forces are found from the weighted (the weighting matrix must be derived from experimental data on the force changes resulting from changes in attitude; see Refs. 5 and 6) steady aerodynamic influence coefficients (AICs), and/or a set of experimentally determined control point force coefficients

$$\{F_a\} = (qS/\bar{c})[W][C_{h_s}]\{h\} + qS\{C_{z_r}^{(e)}\} \quad (1)$$

The use of the experimental force coefficients is generally necessary to account for the aeroelastic behavior arising from camber and/or wing-body interference. The inertial forces are found from the mass matrix

$$\{F_i\} = [M]\{n\} \quad (2)$$

The total force distribution therefore becomes

$$\{F\} = \{F_a\} + \{F_i\} \quad (3a)$$

$$= (qS/\bar{c})[W][C_{h_s}]\{h\} + qS\{C_{z_r}^{(e)}\} + [M]\{n\} \quad (3b)$$

The deflection mode  $\{h\}$  is composed of the initial deflection mode of the rigid surface  $\{h_r\}$ \* the thermal distortion mode (which may be considered to be initially built in) which is found from the incremental temperature distribution and the matrix of thermal influence coefficients (TICs), and the deformation mode of the flexible surface  $\{h_f\}$

$$\{h\} = \{h_r\} + [a_T]\{t\} + \{h_f\} \quad . \quad (4)$$

The deformation mode of the flexible surface is found from the total force distribution and the matrix of structural influence coefficients (SICs)

$$\{h_f\} = K[a]\{F\} \quad , \quad (5)$$

where K is a normalizing factor to the SICs (introduced for convenience in studying variations in stiffness levels). Combining Eqs. (3b), (4), and (5) permits the solution for the deformation mode

$$\{h_f\} = K[A][a]\{F_r\} \quad , \quad (6)$$

where  $\{F_r\}$  is the force distribution on the rigid system (again considering the thermal distortion to be initially built in).

$$\{F_r\} = (qS/\bar{c})[W][C_{h_s}](\{h_r\} + [a_T]\{t\}) + qS\{C_{z_r}^{(e)}\} + [M]\{n\} \quad , \quad (7)$$

---

\*A distinction is made later in the derivation [see discussion preceding Eq. (31)] between two sources of the initial deflection mode: that arising from any built-in twist or camber and that arising from the attitude (sometimes called the additional deflection mode). The program computes the initial deflection mode as the sum of these,  $\{h_r\} = H_0\{h_r/H_0\} + H\{h/H\}$ , and both sets of data are required. The distinction is not made at this point because it is not essential to the derivation.

where

$$[A] = ([I] - (K_q S / \bar{c})[a][W][C_{hs}])^{-1} \quad (8)$$

The total force distribution is found by returning to Eq. (3b) with Eqs. (4) and (6)

$$\{F\} = [B]\{F_r\} \quad (9)$$

where

$$[B] = [I] + (K_q S / \bar{c})[W][C_{hs}][A][a] \quad (10)$$

For the purpose of structural analysis, it is often convenient to convert the control point forces into the structural loads of shear, moment and torque at particular stations. A set of transformation matrices may be defined to compute

the shear

$$\{V\} = [V/F]\{F\} \quad (11)$$

the moment

$$\{M\} = [M/F]\{F\} \quad (12)$$

and the torque

$$\{T\} = [T/F]\{F\} \quad (13)$$

Each element in the load coefficient matrices is the load at a particular station due to a unit control point force.

In certain longitudinal problems, it is desirable to adjust the attitude so that the flexible system sustains a specified total aerodynamic force. If we denote the specified total by  $Z$ , then

$$[I] \left( \{F\} - [M] \{n\} \right) = Z \quad (14)$$

and if we extend the definition of  $\{h_r\}$  in Eq. (4) to include the change in pitch attitude, we have

$$\{h_r\} = \{h_{r0}\} - \Delta\theta \{x\} \quad (15)$$

The substitution of Eqs. (7), (9), and (15) into Eq. (14) leads to the solution for the incremental pitch angle

$$\Delta\theta = (1/D)(C - Z) \quad (16)$$

where

$$C = [I] \left( [B] \{F_{r0}\} - [M] \{n\} \right) \quad (17)$$

$$D = (qS/\bar{c}) [I] [B] [W] [C_{hs}] \{x\} \quad (18)$$

and

$$\{F_{r0}\} = (qS/\bar{c}) [W] [C_{hs}] \left( \{h_{r0}\} + [a_T] \{t\} \right) + qS \{C_{z_r}^{(e)}\} + [M] \{n\} \quad (19)$$

The final force distribution in this case follows from Eqs. (7), (9), (15), and (19)

$$\{F\} = [B]\{F_{r_0}\} - \Delta\theta(qS/\bar{c})[B][W][C_{h_s}]\{x\} \quad (20)$$

The final deflection mode follows from Eqs. (4), (5), (15), and (20)

$$\{h\} = \{h_{r_0}\} - \Delta\theta\{x\} + K[a]\{F\} + [a_T]\{t\} \quad (21)$$

A variation of the foregoing is found in maintaining a constant total force equal to that given by the rigid condition (without the thermal distortion). In this case

$$Z = qS[I]\left((1/\bar{c})[W][C_{h_s}]\{h_{r_0}\} + \{C_{z_r}^{(e)}\}\right) \quad , \quad (22)$$

and Eqs. (16), (17), (18), (20), and (21) provide the solution for the final force distribution and deflection mode.

The possibility of divergence is seen in Eq. (6) as the inverse of the matrix  $[A]$  approaches singularity. The critical values of  $(Kqs/\bar{c})$  that yield a singularity are related to the eigenvalues of the matrix, and the divergence condition is specified by the eigenvalues of the equation

$$\lambda\{h_f\} = [a][W][C_{h_s}]\{h_f\} \quad , \quad (23)$$

where

$$\lambda = \bar{c}/KSq_{div} \quad , \quad (24)$$

from which the divergence dynamic pressure is found

$$q_{div} = \bar{c}/\lambda KS \quad (25)$$

Any positive value of  $q_{div}$  shows a divergence possibility although usually only the first or second values have any practical significance. The corresponding eigenvectors of Eq. (23) are the divergence modes.

The foregoing development of the force distribution on the flexible system provides the basis for estimating aerodynamic stability derivatives. The aerodynamic coefficients are defined by the following:

$$C_Z = Z/qS \quad (26a)$$

$$= (1/qS)[I] \left( \{F\} - [M]\{n\} \right) \quad (26b)$$

$$C_m = \mathcal{M}/qS\bar{c} \quad (27a)$$

$$= -(1/qS\bar{c})[x - x_o] \left( \{F\} - [M]\{n\} \right) \quad (27b)$$

$$C_l = \mathcal{L}/qSs \quad (28a)$$

$$= (1/qSs)[y] \left( \{F\} - [M]\{n\} \right) \quad (28b)$$

The center of pressure is found from

$$(\bar{x} - x_o)/\bar{c} = -\mathcal{M}/Z \quad (29a)$$

$$= -C_m/C_Z \quad (29b)$$

$$y/s = \mathcal{L}/Z \quad (30a)$$

$$= C_l/C_Z \quad (30b)$$

The force distribution for use in the above equations is found from Eqs. (7) and (9). To derive the stability derivatives, it is convenient to define a reference generalized deflection  $H$ , a reference temperature change  $T$ , and a reference load factor  $N$ . It is further convenient to consider an initial deflection mode  $\{h_r\} = H_0\{h_r/H_0\}$  where  $H_0$  is a reference initial deflection as distinct from that caused by the attitude change (additional deflection) specified by  $H$ .<sup>\*</sup> These modifications permit Eq. (7) to be rewritten in a more general form

$$\{F_r\} = qS \left( \{C_{z_r}^{(e)}\} + (1/\bar{c})[W][C_{h_s}]\{H_0\{h_r/H_0\} + H\{h/H\} + T[a_T]\{t/T\}\} \right) + N[M]\{n/N\} \quad (31)$$

The initial coefficients and the stability derivatives are defined by

$$C_Z = C_{Z_0} + C_{Z_H} H + C_{Z_T} T + C_{Z_N} N \quad (32)$$

$$C_m = C_{m_0} + C_{m_H} H + C_{m_T} T + C_{m_N} N \quad (33)$$

$$C_l = C_{l_0} + C_{l_H} H + C_{l_T} T + C_{l_N} N \quad (34)$$

where  $C_{Z_H}$ ,  $C_{Z_T}$ , and  $C_{Z_N}$  are examples of aerodynamic, thermal and inertial derivatives, respectively. The substitutions of Eqs. (9) and (31) into Eqs. (26b), (27b), and (28b) and a comparison with the coefficients of  $H$ ,  $T$ , and  $N$  in Eqs. (32) through (34) yields the following. The initial

---

<sup>\*</sup> See footnote, p. 3.

coefficients are

$$C_{Z_o} = [I][B]\{C_{z_r}\} \quad (35)$$

$$C_{m_o} = -(1/\bar{c})[x - x_o][B]\{C_{z_r}\} \quad (36)$$

$$C_{\zeta_o} = (1/s)[y][B]\{C_{z_r}\} \quad (37)$$

where

$$\{C_{z_r}\} = \{C_{z_r}^{(e)}\} + (H_o/\bar{c})[W][C_{h_s}]\{h_r/H_o\} \quad (38)$$

The aerodynamic stability derivatives are

$$C_{Z_H} = [I][B]\{C_{z_{Hr}}\} \quad (39)$$

$$C_{m_H} = -(1/\bar{c})[x - x_o][B]\{C_{z_{Hr}}\} \quad (40)$$

$$C_{\zeta_H} = (1/s)[y][B]\{C_{z_{Hr}}\} \quad (41)$$

where

$$\{C_{z_{Hr}}\} = (1/\bar{c})[W][C_{h_s}]\{h/H\} \quad (42)$$

The thermal derivatives are

$$C_{Z_T} = [I][B]\{C_{z_T}\} \quad (43)$$

$$C_{m_T} = -(1/\bar{c})[x - x_0][B]\{C_{z_T}\} \quad (44)$$

$$C_{l_T} = (1/s)[y][B]\{C_{z_T}\} \quad (45)$$

where

$$\{C_{z_T}\} = (1/\bar{c})[W][C_{h_s}][a_T]\{t/T\} \quad (46)$$

Finally, the inertial derivatives are

$$C_{Z_N} = [I]\{C_{z_N}\} \quad (47)$$

$$C_{m_N} = -(1/\bar{c})[x - x_0]\{C_{z_N}\} \quad (48)$$

$$C_{l_N} = (1/s)[y]\{C_{z_N}\} \quad (49)$$

where

$$\{C_{z_N}\} = (K/\bar{c})[W][C_{h_s}][A][a][M]\{n/N\} \quad (50)$$

The center of pressure for each of these loadings is found from Eqs. (29b) and (30b) using the appropriate coefficients or derivatives.

The rigid aerodynamic stability derivatives may be estimated from Eqs. (39) through (42) by taking  $[B] = [I]$  (i. e.,  $q = 0$ ). Equations (39) through (42) may also be used to estimate dynamic stability derivatives by using the (complex) oscillatory AICs which are defined by

$$\{F\} = \rho \omega^2 b_r^2 s [W][C_h]\{h\} \quad (51)$$

By comparing this definition to the steady definition of Eq. (1), we see it is only necessary to replace  $[C_{h_g}]$  by  $2k_r^2 (\bar{c}s/S)[C_h]$  and to permit  $\{h/H\}$  to become complex in order to make all of the preceding development applicable to the oscillatory case. Since this is a significant feature of the present analysis, we digress to illustrate the calculation in some detail. We choose as an example the estimation of the symmetrical longitudinal stability derivatives. We begin with the general expressions for the lift and moment coefficients for transient longitudinal motion.

$$C_Z = C_{Z_a} + C_{Z_{D_a}} (\dot{a}\bar{c}/2V) + C_{Z_q} (\dot{\theta}\bar{c}/2V) \\ + C_{Z_{D_a}^2} (\ddot{a}\bar{c}^2/4V^2) + C_{Z_{D_q}} (\ddot{\theta}\bar{c}^2/4V^2) + \dots \quad (52)$$

$$C_m = C_{m_a} + C_{m_{D_a}} (\dot{a}\bar{c}/2V) + C_{m_q} (\dot{\theta}\bar{c}/2V) \\ + C_{m_{D_a}^2} (\ddot{a}\bar{c}^2/4V^2) + C_{m_{D_q}} (\ddot{\theta}\bar{c}^2/4V^2) + \dots \quad (53)$$

If we truncate the series at the points shown in Eqs. (52) and (53), and consider the case of harmonic pitching ( $\theta = a$ ) with amplitude  $a_o$ , then

$$C_Z = a_o \left[ C_{Z_a} + ik \left( C_{Z_{D_a}} + C_{Z_q} \right) - k^2 \left( C_{Z_{D_a}^2} + C_{Z_{D_q}} \right) \right] \quad (54)$$

$$C_m = a_o \left[ C_{m_a} + ik \left( C_{m_{D_a}} + C_{m_q} \right) - k^2 \left( C_{m_{D_a}^2} + C_{m_{D_q}} \right) \right] \quad (55)$$

where the reduced frequency  $k = \omega \bar{c} / 2V$ . In the case of harmonic plunging ( $\theta = 0$ ,  $\alpha = \dot{h}/V$ ) with amplitude  $h_0$ , then

$$C_Z = h_0 (2/\bar{c}) \left[ ik C_{Z_\alpha} - k^2 C_{Z_{D\alpha}} - ik^3 C_{Z_{D^2\alpha}} \right] \quad (56)$$

$$C_m = h_0 (2/\bar{c}) \left[ ik C_{m_\alpha} - k^2 C_{m_{D\alpha}} - ik^3 C_{m_{D^2\alpha}} \right] \quad (57)$$

The lift and moment coefficients can also be found from Eqs. (39), (40), and (42) by making the substitutions noted above (i. e.,  $[B] = [I]$ , and replacing  $[C_{h_s}]$  by  $2k_r^2 (\bar{c}s/S) [C_h]$ ).

$$C_Z = H [I] \{C_{Z_{Hr}}\} \quad (58)$$

$$C_m = -H (1/\bar{c}) [x - x_0] \{C_{Z_{Hr}}\} \quad (59)$$

where

$$\{C_{Z_{Hr}}\} = 2k_r^2 (s/S) [W] [C_h] \{h/H\} \quad (60)$$

To appraise the various longitudinal derivatives it is necessary to evaluate Eqs. (58) through (60) for both motions, pitching and plunging. For pitching about station  $x_1$ , the reference deflection is taken as  $H = \alpha_0$ , and the additional deflection mode is  $\{h/H\} = \{x_1 - x\}$ ; for plunging, the reference deflection is  $H = h_0$ , and the additional deflection mode is  $\{h/H\} = \{I\}$ . The computational sequence is now evident. The evaluation of Eqs. (58) and (59) for the plunging motion yields two complex numbers which, when identified with the real and imaginary parts of Eqs. (56) and (57), lead to the four derivatives  $C_{Z_{D\alpha}}$ ,  $C_{m_{D\alpha}}$ ,  $C_{Z_{D^2\alpha}}$ , and  $C_{m_{D^2\alpha}}$  (assuming, of course, that the static stability derivatives  $C_{Z_\alpha}$  and  $C_{m_\alpha}$  have already been determined).

A similar evaluation of Eqs. (58) and (59) for the pitching motion yields another set of two complex numbers which, when identified with the real and imaginary parts of Eqs. (54) and (55), and with appropriate utilization of the angle of attack derivatives determined previously, lead to the remaining derivatives  $C_{Zq}$ ,  $C_{mq}$ ,  $C_{ZDq}$ , and  $C_{mDq}$ . In a similar manner, many of the lateral-directional dynamic stability derivatives can be found from oscillatory AICs.

Our treatment of the stability derivatives provides a means of estimating a dimensionless spanwise load distribution and the spanwise variation of the chordwise center of pressure on a lifting surface. This calculation requires the data on which the AICs are based, i. e., the location and number of the chordwise control points, and the widths of the strips into which the surface has been divided. The load distribution coefficients are needed to make these calculations. The flexible load distribution coefficients are given by

$$\{C_{zf}\} = [B]\{C_z\} \quad , \quad (61)$$

where  $\{C_z\}$  denotes any of the various distributions for the different loads except for the inertial loads; i. e.,  $\{C_z\}$  can be taken to represent any of  $\{C_{zr}\}$ ,  $\{C_{zHr}\}$ , or  $\{C_{zT}\}$ ; in the inertial case,  $\{C_{zN}\}$  is used directly, i. e.,  $\{C_{zf}\} = \{C_{zN}\}$ . The elements of  $\{C_{zf}\}$  are listed in order for each surface strip as derived in the AICs and can be used to find the local dimensionless loading and center of pressure. Let us denote the sum of the load coefficients on the ith strip by

$$\Delta C_{Z_i} = \sum_{\text{strip } i} C_{zf} \quad (62)$$

and the moment about the leading edge by

$$\Delta C_{m_i} = \sum_{\text{strip } i} \xi C_{zf} \quad , \quad (63)$$

where  $\xi$  is the dimensionless chordwise location of each control point aft of the leading edge. Then the spanwise loading on the  $i$ th strip is given by

$$(c_l c / \bar{c})_i = -\Delta C_{Z_i} (s / \Delta y_i) \quad (64)$$

where  $\Delta y_i$  is the load strip width. The local center of pressure is given by

$$\xi_i = \Delta C_{m_i} / \Delta C_{Z_i} \quad (65)$$

The problem of reducing wind tunnel data is our last consideration. The purpose of a wind tunnel test is the measurement of the so-called rigid loads on the configuration (unless the model is specifically designed for aeroelastic measurements). But since no model is completely rigid, some aeroelastic correction can be made to any wind tunnel measurement. We now consider this correction. The situation is described by Eq. (61), which may be written as

$$\{C_{Z_f}^{(e)}\} = [B_m] \{C_{Z_r}^{(e)}\} \quad (66)$$

where  $\{C_{Z_f}^{(e)}\}$  is the set of force coefficients measured on the flexible model,  $[B_m]$  is the aeroelastic amplification matrix based on the model properties from Eq. (10), and  $\{C_{Z_r}^{(e)}\}$  is the set of desired force coefficients on the rigid configuration. Obviously the rigid force coefficients follow from the inverse of Eq. (66)

$$\{C_{Z_r}^{(e)}\} = [B_m]^{-1} \{C_{Z_f}^{(e)}\} \quad (67)$$

The rigid force coefficients so determined then provide the starting point for the aeroelastic analysis of the prototype.

D. References

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## SECTION II

### GENERAL DESCRIPTION OF INPUT

#### A. Units

All units are taken in the pound-inch system with two exceptions: the surface area is in square feet, and the dynamic pressure is in pounds per square foot.

#### B. Example Problem

We consider the static aeroelastic analysis of the five strip wing whose geometry is shown in Fig. 1. This is the jet transport wing analyzed by Bisplinghoff, Ashley, and Halfman throughout Ref. 7. We will use the following program options: trimmed loads with the structural loads suboption, divergence, aerodynamic stability derivatives (due to angle of attack), and inertial derivatives (due to symmetrical load factor). We proceed to assemble the data required as input to the program when it is to perform these options. The flexibility, mass, and aerodynamic influence coefficient matrices (all size  $10 \times 10$ ) are printed in the program output example (pp. 45 through 48) and need not be shown here. The flexibility and mass matrices are taken from Ref. 1; the aerodynamic influence coefficients are developed from the subsonic lifting surface method of Ref. 8 at a Mach number of zero. We shall list only the additional data needed for the representative options. A basic list of constants can be used for all of the options and is given below:

$$\bar{c} = 225 \text{ inches}$$

$$K = 1.0 \times 10^{-7}$$

$$S = 564.236 \text{ square feet}$$

$$Z = -41,919 \text{ pounds (this is the lift on one wing required in level flight neglecting any tail load or fuselage lift, and taking one-half the fuselage weight as 17,400 pounds)}$$

$$H = 1.0$$

$$\begin{aligned}
T &= 0 \\
N &= 1.0 \\
s &= 500 \text{ inches} \\
x_o &= 0 \\
H_o &= 0
\end{aligned}$$

For the loads option we make the following assumptions: the aircraft is to be trimmed at three values of dynamic pressure:  $q = 400, 800, \text{ and } 1200$  psf; the aerodynamic matrix needs no experimental correction (the weighting matrix is taken as unity); no lift has been derived experimentally ( $\{C_{z_r}^{(e)}\} = \{0\}$ , size  $10 \times 1$ ); there is no initial deflection mode ( $\{h_r/H_o\} = \{0\}$ , size  $10 \times 1$ ); the additional deflection mode corresponds to zero angle of attack ( $\{h/H\} = \{0\}$ , size  $10 \times 1$ ); and the symmetrical load factor distribution matrix is a unit column ( $\{n/N\} = \{I\}$ , size  $10 \times 1$ ). The control point chordwise coordinate matrix for use in the trim analysis is

$$\{x\} = \begin{Bmatrix} 20.25 \\ -81.00 \\ 17.85 \\ -71.40 \\ 15.80 \\ -63.20 \\ 13.30 \\ -53.20 \\ 11.05 \\ -44.20 \end{Bmatrix} \text{ (inches)}$$

measured from the (unswept) 35 percent chord line as shown in Fig. 1. The final data necessary to compute the structural loads are the shear, moment, and torque coefficient matrices. Considering only the loads at the side of the fuselage, we have

$$[V/F] = [I], \text{ size } 1 \times 10,$$

$$[M/F] = [45 \ 45 \ 141 \ 141 \ 223 \ 223 \ 323 \ 323 \ 413 \ 413],$$

$$\begin{aligned}
[T/F] = [-20.25 \ +81.00 \ -17.85 \ +71.40 \ -15.80 \ +63.20 \ -13.30 \ +53.20 \ -11.05 \\
\quad +44.20].
\end{aligned}$$

The divergence option may be run simultaneously with the loads option since it requires only a portion of the above information. We request two divergence modes and dynamic pressures to be found.

The aerodynamic derivatives options will be carried out for the rigid case ( $q = 0$ ) in addition to the previous list of dynamic pressures. The additional deflection mode  $\{h/H\}$  used in the aerodynamic stability derivatives will be based on a one-radian angle of attack mode and is found from

$$\{h/H\} = -\{x/57.296\} = \begin{Bmatrix} -0.35343 \\ 1.41371 \\ -0.31154 \\ 1.24616 \\ -0.27576 \\ 1.10304 \\ -0.23213 \\ 0.92851 \\ -0.19286 \\ 0.77143 \end{Bmatrix} \text{ (per degree)}$$

The calculation of the load distribution and the rolling moment coefficient requires the following additional data shown in Fig. 1: the spanwise coordinate matrix

$[y] = [90 \ 90 \ 186 \ 186 \ 268 \ 268 \ 368 \ 368 \ 458 \ 458]$  (inches),

and the width of each strip and the dimensionless chordwise location of each control point on the strip.

<u>Strip No.</u>	<u><math>\Delta y</math></u>	<u><math>\xi_f</math></u>	<u><math>\xi_a</math></u>
1	93	0.25	0.75
2	89	0.25	0.75
3	91	0.25	0.75
4	95	0.25	0.75
5	87	0.25	0.75

It is possible to perform all or any selected number of program options with one input deck if all data are real, although, in the example problem taking  $\{h/H\} = \{0\}$  in the loads option does not permit calculation of the aerodynamic stability derivatives and taking  $q = 0$  in the stability derivative option (to find derivatives for a rigid system) is not compatible with the trimmed loads option which requires  $q > 0$ . To avoid computing irrelevant results, we use two data decks, reproducing the cards (data) in the first deck that can be used as a part of the second deck.

C. Program Restrictions and Options

1. Maximum matrix size is  $50 \times 50$ .
2. Maximum number of dynamic pressures per deck is 10.
3. Provision has been made to reserve a partition in the upper left-hand corner of the total AIC matrix for control points (and the flexibility and mass matrices must be compatible with this order of control points) whose aerodynamic forces may be neglected or found from an alternate theory to that used for the primary control points. This partition is termed the "external store" region since external stores are an example of a source of additional control points requiring such special consideration. The maximum number of control points that can be reserved for external stores is 49.
4. Maximum number of modes to be evaluated for the divergence option is 25.
5. For real and complex derivative calculations, the maximum number of strips is 20; the maximum number of control points per strip is 10.
6. Multiple options may be performed with one deck except for the following restrictions:
  - a. The structural loads option must be used as a suboption to the other loads options.

b. In any one input deck, all data must be for steady case (real) options or all data must be for oscillatory case (complex) options.

c. The divergence option cannot be used in the complex case.

7. Only one matrix of associated aerodynamic influence coefficients may be included in any one deck. When external stores are present, the matrix includes the AICs for the stores; however, this area may be set to zero.

8. In the oscillatory case, the following data must be input in complex form: AIC matrix, temperature mode, experimental forces, initial deflection mode, additional deflection modes, and load factor mode.

9. Program options and significant equation numbers as assigned in Part C, Section I are listed below.

- a. Loads for constant root angle of attack; Eqs. (31) and (9).
- b. Loads for trimmed condition; Eqs. (31) and (20).
- c. Loads for constant lift coefficient; Eqs. (22), (31), and (20).
- d. Divergence, Eq. (23).
- e. Initial coefficients; Eqs. (35) through (37).
- f. Aerodynamic stability derivatives; Eqs. (39) through (41).
- g. Thermal derivatives; Eqs. (43) through (45).
- h. Inertial derivatives; Eqs. (47) through (49).
- i. Experimental data reduction; Eq. (67).
- j. Structural loads; Eqs. (11) through (13).

### SECTION III

#### DATA DECK SETUP

##### A. Loading Order

Data decks are loaded behind column binary deck LD003A. There are nineteen items that can be used in the data deck. The deck is set up with the items entered in the following order:

1. Heading card
2. Data deck control card
3. Constants cards
4. Dynamic pressure card(s)
5. Flexibility matrix
6. Aerodynamic matrix
7. Weighting matrix
8. Thermal matrix
9. Temperature mode
10. Experimental force column
11. Initial deflection mode
12. Additional deflection mode
13. Mass matrix
14. Load factor column
15. Chordwise coordinates
16. Spanwise coordinates
17. Strip widths and control point locations (percent chord)

18. Load coefficient matrices (shear, moment, torque)

19. Second and successive "additional deflection mode" columns

Items 1, 2, 3, and 6 must be present in all data decks; the presence (or absence) of the other items is determined by the option and data indicators used in the data deck control card (Item 2).

B. Input Data Description

1. The heading card may contain any alphanumeric characters desired in Columns 2 through 80. It is normally used for job title, engineer's name, and data.

2. Data deck control card (FORMAT 1814): This card specifies which options are to be performed and also indicates the presence of certain data. The eighteen fields of this card are used as follows:

Field 1. Column 4 contains a 1 if load option 1 (LOADS FOR CONSTANT ROOT ANGLE OF ATTACK) is to be performed; it contains a zero or blank if not to be performed.

Field 2. Column 8 contains a 1 if load option 2 (LOADS FOR TRIMMED CONDITION) is to be performed, a zero or blank if not.

Field 3. Column 12 contains a 1 if load option 3 (LOADS FOR CONSTANT LIFT COEFFICIENT) is to be performed, a zero or blank if not.

Field 4. Column 16 contains the number of modes (25 maximum) of the DIVERGENCE option to be performed, a zero or blank if not.

Field 5. Column 20 contains a 1 if the INITIAL COEFFICIENTS option is to be performed, a zero or blank if not.

- Field 6. Columns 23 and 24 contain the number of solutions for AERODYNAMIC STABILITY DERIVATIVES desired. This option permits varying the "additional deflection mode"  $\{h/H\}$  when the other data are unchanged. The first mode is included as Data Item 12, and the second and successive modes are included as Data Item(s) 19.
- Field 7. Column 28 contains a 1 if the problem is complex, a zero or blank if all data are real.
- Field 8. Column 32 contains a 1 if the THERMAL STABILITY DERIVATIVES option is to be performed, a zero or blank if not.
- Field 9. Column 36 contains a 1 if the INERTIAL DERIVATIVES option is to be performed, a zero or blank if not.
- Field 10. Column 40 contains a 1 if a weighting matrix is included in the data deck, a zero or blank if excluded.
- Field 11. Column 44 contains a 1 if a thermal matrix and associated temperature mode are included in the data deck, a zero or blank if excluded.
- Field 12. Column 48 contains a 1 if an experimental force column matrix is included in the data deck, a zero or blank if excluded.
- Field 13. Columns 51 and 52 contain the number of elements (control points) reserved for external stores, a zero or blank if none is reserved.
- Field 14. Columns 55 and 56 contain the number of dynamic pressures (10 maximum) for which cycling options (repeated for each "q") are to be performed.

Field 15. Column 60 contains a 1 if the EXPERIMENTAL DATA REDUCTION option is to be performed, a zero or blank if not.

Field 16. Column 64 contains a 1 if the STRUCTURAL LOADS option is to be performed, a zero or blank if not.

Field 17. Columns 67 and 68 indicate the order of the system contained in the data deck (50 maximum).

Field 18. Column 72 contains a 1 if the flexibility matrix is present in the data deck, a zero or blank if absent.

In the subsequent description of input data we find it convenient to refer to above fields 1, 2, 3, 4, 5, 6, 8, 9, 15, and 16 as Options identified by the respective field numbers. The other fields contain control numbers and will be referred to as Item 2, Field (respective number).

3. Constants cards (FORMAT 6E12.8): The two constants cards contain the items listed in the following order:

- a. CBAR: mean aerodynamic chord
- b. FLEXX: flexibility matrix normalizing constant (or scaling factor); when the matrix has not been normalized FLEXX = 1.0
- c. CAPS: surface reference area
- d. CAPZ: vertical force
- e. CAPH: generalized reference deflection
- f. CAPT: reference temperature change
- g. CAPN: reference load factor
- h. SMALS: surface span measured from root to tip
- i. CAPXO: coordinate pitching moment reference axis
- j. CAPHO: reference deflection for initial deflection mode

4. Dynamic pressures (FORMAT 6E12.8): If six or fewer dynamic pressures are listed, one card is used; seven through 10 pressures require two cards. The q card(s) are not required when performing Option 4 (divergence) above, but unless Item 2, Field 14 is zero or blank, the q's must be input and must agree with the number in this field.

5. The flexibility matrix  $[a]$  is input if its presence has been indicated in the data deck control card (Item 2, Field 18). If not included as input, a rigid case is assumed ( $[a] = [0]$ ). The following card order and formats must be used when the matrix is input.

a. Control card (FORMAT 18I4)

Field 1. Columns 3 and 4 contain m, the number of rows in the matrix ( $\leq 50$ ).

Field 2. This field is not used; it may be left blank.

Field 3. Column 12 contains IFORM; if IFORM = 1, the matrix elements are to be input using FORTRAN FORMAT 6E12.8; if IFORM = 0, the elements will be input using column binary format.

Field 4. Column 16 contains IROW; if IROW = 1, the matrix elements are input by row; if IROW = 0, the elements are input by column.

b. Matrix elements (use format specified above)

If IFORM = 1, and IROW = 1: use FORMAT 6E12.8 and input the matrix element by row; each new row starts on a new card (line).

If IFORM = 1, and IROW = 0: use FORMAT 6E12.8 and input the elements by column with each new column beginning on a new card.

If IFORM = 0, IROW must = 0: the matrix elements are input using column binary format. This format should be used only if the data are available as punched-card output from appropriate computer programs. The elements must be punched by columns; Column 1 starts in Origin 1 and Column 2 starts in Location  $(1 + m)$ . A TRA card must end the deck. (This transfer card has a 7 and a 9 punch in Column 1, Columns 2 through 72 are blank, and Columns 73 through 80 will contain the characters used for identifying and sequencing the deck.)

6. The aerodynamic matrix  $[C_h]$  is always present in the data deck. It consists of two parts if external stores have been reserved in Item 2, Field 13, and it is real (steady case) unless indicated as complex (oscillatory case) in Item 2, Field 7. The  $[C_h]$  matrix must be entered as follows with this exception: Items a and b (below) will be omitted when no external stores are reserved:

a. Control card for store  $[C_h]$  (FORMAT 1814)

Field 1. Columns 3 and 4 contain  $m$ , number of control points reserved for external stores ( $\leq 49$ );  $m = 0$  will direct the program to set the store  $[C_h]$  to zero.

Field 2. This field is not used, it may be left blank.

Field 3. Column 12 contain IFORM as defined in Item 5a.

Field 4. Column 16 contains IROW as defined in Item 5a.

b. Store matrix elements (format specified in Fields 3 and 4, above control card): Omit this input if  $m = 0$  is used in the control card. When the external stores  $[C_h]$  matrix is input, use the format in the manner described in Item 5b. If the matrix elements are complex numbers (oscillatory case) consider the matrix size as  $m \times 2m$  (imaginary parts of the elements form the even-numbered columns) and input as though all elements were real numbers.

c.  $1/k_r$  card (FORMAT 6E12.8): The reference reduced velocity card is always present. For the steady case, it may be blank or contain any number, but for the oscillatory case it must be the  $1/k_r$  associated with the aerodynamic matrix.

d. Control card for surface  $[C_h]$  matrix (FORMAT 1814)

Field 1. Columns 3 and 4 contain  $m$ , the number of control points on the surface. ( $m = \text{size of system minus number of store control point.}$ )

Field 2. Columns 7 and 8 contain  $L$ , the number of strips (partitions) in the surface.  $L = 1$  for a full (unpartitioned) matrix.

Field 3. Column 12 contains IFORM as previously defined.

Field 4. Column 16 contains IROW as previously defined.

e. The input listed below must be repeated for each partition ( $i = 1, L$ ).

(1) Partition size (FORMAT 18I4)

Field 1. Columns 3 and 4 contain  $n$ , the number of control points on strip  $i$  (size of partition  $i$ ). If  $L = 1$ ,  $n$  = total number of control points on the surface.

(2) Matrix elements in partition  $i$  (format specified in control card, Item 6d).

When the matrix is for the steady case the elements in each partition are input in the same manner as the elements in the  $[a]$  matrix (Item 5b). In the oscillatory case, the elements are entered in the same manner as described for the stores oscillatory  $[C_h]$  matrix (Item 6b).

Note: Punched cards output from IBM programs based on the sources listed below may be used (with no alterations) for Items 6c, 6d, and 6e when the theory is appropriate to the problem. Punched cards output from the program based on slender-body theory may be used for Items 6a and 6b if the first card ( $1/k_r$ ) is removed from the deck. The list shown is complete only at this writing; additional compatible sources are currently under development.

W. P. Rodden, E. F. Farkas, H. Malcom, and A. M. Kliszewski.  
"Aerodynamic Influence Coefficients from Incompressible Strip Theory: Analytical Development and Computational Procedure." Aerospace Corp. Report No. TDR-169(3230-11)TN-5, 3 September 1962.

W. P. Rodden, E. F. Farkas, H. Malcom, and A. M. Kliszewski. "Aerodynamic Influence Coefficients from Supersonic Strip Theory: Analytical Development and Computational Procedure." Aerospace Corp. Report No. TDR-169(3230-11)TN-1, 1 August 1962.

W. P. Rodden, E. F. Farkas, H. Malcom, and A. M. Kliszewski. "Aerodynamic Influence Coefficients from Piston Theory: Analytical Development and Computational Procedure." Aerospace Corp. Report No. TDR-169(3230-11)TN-2, 15 August 1962.

W. P. Rodden, E. F. Farkas, and G. Y. Takata. "Aerodynamic Influence Coefficients from Slender-Body Theory: Analytical Development and Computational Procedure." Aerospace Corp. Report No. TDR-169(3230-11)TN-6, 31 October 1962.

7. Weighting matrix: The weighting matrix  $[W]$  is input if its presence has been indicated in Item 2, Field 10. The matrix is entered with formats identical to those given for the  $[C_h]$  matrix (Item 6a, b, c, d, e) with three exceptions: (1) the  $1/k_r$  card (Item 6c) is omitted; (2) in repeating Item 6a if  $m = 0$  the program will use a unit matrix for the store  $[W]$ ; and (3) the matrix is always real. It is not required that  $[C_h]$  and  $[W]$  be input with the same format in the same data deck; i. e., one may be in column binary while the other uses FORTRAN format, and one may be partitioned while the other is a full matrix.

8. Thermal influence coefficients matrix: The thermal matrix  $[a_T]$  is input when Item 2, Field 11 notes its presence. The matrix is required input for Option 8. The formats for entering  $[a_T]$  are the same as those used for the flexibility matrix: Items 5a and 5b.

9. Temperature distribution column (FORMAT 6E12.8): The temperature mode  $\{t/T\}$  always accompanies the above thermal matrix. For steady cases (real AICs), the  $\{t/T\}$  matrix is entered as one column, six elements per card. For oscillatory cases (complex AICs), the mode is complex with the imaginary part considered as a second column; tabulate by column with the second column starting a new card.

10. Experimental force column (FORMAT 6E12.8): The experimental force column  $\{C_{zr}^{(e)}\}$  is input only if its presence has been indicated by Item 2, Field 12. The column (real or complex) is entered in the same manner as the column in Item 9.

11. Initial deflection mode (FORMAT 6E12.8): The initial deflection mode  $\{h_r/H_0\}$ , must be present to perform Option(s) 1, 2, 3, and/or 5. Again refer to Item 9 for entering the column (real or complex). If all elements in the column are zero, a sufficient number of blank cards may be used.

12. Additional deflection mode (FORMAT 6E12.8): The additional deflection  $\{h/H\}$  must be included for Option(s) 1, 2, 3, and/or 6. See Items 9 and 11 for inputting this column (real or complex).

13. Mass matrix: The mass matrix  $[M]$  must be in the data deck when performing Option(s) 1, 2, 3, and/or 9. The matrix is input as follows:

a. Control card 1 (FORMAT 18I4): Field 1 must contain NRC, order of the matrix (same as Item 2, Field 17).

b. Control card(s) 2 through 7 (FORMAT 18I4): Field 1 and consecutive fields in control card 2 and successive control cards contain in order  $LL_1, LH_1, LL_2, LH_2, \dots, LL_{NRC}, LH_{NRC}$ .  $LL_i$  is the row number where the first nonzero element appears in column  $i$ ;  $LH_i$  is the row number where the last nonzero element appears in column  $i$ . If only one nonzero element is in column  $i$ , its row number must be used for both  $LL_i$  and  $LH_i$ .

c. Elements in  $[M]$  matrix (FORMAT 6E12.8): The elements are entered by column as shown below. Each column starts on a new line (card).

Column 1: elements  $LL_1$  through  $LH_1$

Column 2: elements  $LL_2$  through  $LH_2$

Column NRC: elements  $LL_{NRC}$  through  $LH_{NRC}$

Any zero elements between  $LL_i$  and  $LH_i$  must be entered or their respective fields left blank. If all elements in a column are zero, then at least one element must be entered as zero (a blank card may be used);  $LL_i$  and  $LH_i$  for this zero element must appear in the above control cards.

14. Load factor column (FORMAT 6E12.8): The load factor column  $\{n/N\}$  is included if  $[M]$  is used (Option(s) 1, 2, 3, and/or 9). If no correction is desired, input a unit column. The column is real for steady cases and complex for oscillatory cases. (See Item 9 for column input.)

15. Chordwise coordinates (FORMAT 6E12.8): The control point coordinate matrix  $\{x\}$  or  $[x]$  is input for Option(s) 2, 3, 5, 6, 8, 9, and/or 15. The matrix is entered only once (six elements per card) for any combination of the above options.

16. Spanwise coordinates (FORMAT 6E12.8): A spanwise control point coordinate matrix  $[y]$  must be used with Option(s) 5, 6, 8, 9, and/or 15. The elements in  $[y]$  are the control point distances from the roll axis.

17. Strip widths and control point locations (percent chord): The strip widths  $\Delta y_i$  and the control point locations  $\xi_{i,j}$  (given as a fraction of the local chords) are required for Option(s) 5, 6, 8, 9, and/or 15. These data have the following input format.

a. Control card(s) (FORMAT 18I4)

Field 1. This field must contain  $NSTRP$  = number of surface strips (maximum of 20 for above options). Do not include external stores as strips.

Field 2. Field 2 and successive fields contain  $NCPT_i$  = number of control points ( $\leq 10$ ) on strip  $i$ . ( $i = 1, NSTRP$ )

b.  $\Delta y_i$  and  $\xi_{i,j}$  ( $j = 1, NCPT_i$ ) (FORMAT 6E12.8): These data are entered by strips; each strip requires one line (card) when  $NCPT \leq 5$  and two cards when  $NCPT > 5$ . Start with the first card for strip 1 and input the data as follows:

Field 1.  $\Delta y_1$ : width of strip 1.

Field 2.  $\xi_1 1$ : location of first control point for strip 1.

Field 3.  $\xi_1 2$ : location of second control point for strip 1.

.

.

.

Field ( $\text{NCPT}_1 + 1$ ).  $\xi_1 \text{NCPT}_1$ : location of last control point for strip 1. (If  $\text{NCPT} > 5$ , then  $\xi_1 6$  would be in Field 1, second card).

Repeat the above for each strip

18. Transformation matrices for structural loads: The shear, moment, and torque matrices,  $[V/F]$ ,  $[M/F]$ , and  $[T/F]$ , are input only if Option 16 is selected in conjunction with Option(s) 1, 2, or 3. The elements in any specific row of each matrix are the loads at a particular station due to a unit control point force.

The matrices are input in the order in which they are listed (above pp.) with each using the same format (similar to the mass matrix but input by rows instead of columns). The format for  $[V/F]$  is given below; the same format is used for  $[M/F]$  and  $[T/F]$ .

a. Control card 1 (FORMAT 18I4): Field 1 contains NVMT, the number of rows in  $[V/F]$ . Note the matrix size is  $(\text{NVMT} \times \text{NRC})$ , where NRC agrees with Item 2, Field 17 and  $\text{NVMT} \leq 20$ .

b. Control card(s) 2 through 7 (FORMAT 18I4): Field 1 and consecutive fields of these cards contain  $\text{LOW}_1$ ,  $\text{LHIGH}_1$ ,  $\text{LOW}_2$ ,  $\text{LHIGH}_2$ , ...,  $\text{LOW}_{\text{NVMT}}$ ,  $\text{LHIGH}_{\text{NVMT}}$ .  $\text{LOW}_i$  is the column number of the first nonzero element in row  $i$ , and  $\text{LHIGH}_i$  is the column number of the last nonzero element in row  $i$ . ( $i = 1, \text{NVMT}$ )

c. Elements of  $[V/F]$  (FORMAT 6E12.8): The elements are entered by row in the same manner as the columns in  $[M]$ . (Item 13c).

19. Second and successive "additional deflection mode" columns (FORMAT 6E12.8): It is possible to vary the additional deflection modal column {h/H} to obtain two or more solutions for real or complex aerodynamic stability derivatives. Use the input format given for Item 9 (or 12) repeating the format for each new column.

### C. Table of Option Requirements

To aid the program user in data deck setup, the following table shows which of the above described 19 data items are required to make up a data deck for any option.

		DATA ITEM																		
OPTION		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	1	P	P	P	P	P	P	O	O	O	O	P	P	P	P	A	A	A	-	A
	2	P	P	P	P	P	P	O	O	O	O	P	P	P	P	P	A	A	-	A
	3	P	P	P	P	P	P	O	O	O	O	P	P	P	P	P	A	A	-	A
	4	P	P	P	A	P	P	O	A	A	A	A	A	A	A	A	A	A	A	A
	5	P	P	P	P	O	P	O	A	A	O	P	A	A	A	P	P	P	A	A
	6	P	P	P	P	O	P	O	A	A	A	A	P	A	A	P	P	P	A	O
	8	P	P	P	P	O	P	O	P	P	A	A	A	A	A	P	P	P	A	A
	9	P	P	P	P	O	P	O	A	A	A	A	A	P	P	P	P	P	A	A
	15	P	P	P	P	P	P	O	A	A	P	A	A	A	A	P	P	P	A	A
	16	← Set up for option (1, 2, or 3) being performed →																	A	P

P = must be present; A = must be absent; O = optional inclusion;  
 -= present when Option 16 is used with Option 1, 2, or 3.

Note: The above table applies to options performed singly with the exception of Option 16 which must be used concurrently with Option 1, 2, or 3. Where multiple options are to be performed with one data deck and an item must be present for one of the options and absent for another, that item must be included in the data deck. Also any data item indicated as present in the control card (Item 2) must be included in the deck, even though it may not be used in the particular option(s) chosen.

D. Example Keypunch Forms

Example keypunch forms are given on the following pages. Columns 73 through 80 are reserved for data deck identification and sequencing. Only the cards with sequencing are used in the two data decks set up for the example problem; the lines with Columns 73 through 80 left blank are for description of input.

[illegible]



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
2																																																												HMO30051																			
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-1330	+02+5320	+02-1105	+02+4420	+02																																																																																															
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The above sequenced cards make up the data deck for the example trimmed loads and divergence problems.																																																																																																			

EXAMPLE PROBLEM - AERO DYNAMIC STABILITY AND INERTIAL DERIVATIVES										MM031001									
Data Deck Control Card																			
1										1									
Dynamic Pressures										4									
0.0										05									
400.0										1200.0									
Additional Deflection Mode [h/H]																			
-35343										+00+1.41371 +00-31154 +00+124616 +01-27576 +00+110304 +01									
-23213										+00+92851 +00-19286 +00+77143 +00									
Spanwise Coordinates [y]																			
90.0										186.0									
368.0										458.0									
Number of Strips and Number of Control Points per Strip																			
5										2									
Strip Widths ( $\Delta y_i$ ) and Percent Chord Locations ( $\xi_i$ ) of Control Points																			
93.0										25									
89.0										25									
91.0										25									
95.0										25									
MM031093																			

87.0	+25	+00+75	+00
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The data deck for the example derivative options is set up using the above sequenced cards plus the following cards from the previous deck.

MMO3003-04	-	Constants Cards
06-26	-	Flexibility Matrix
27-49	-	Aerodynamic Matrix
50-65	-	Weighting Matrix
70-84	-	Mass Matrix and Load Factor Column
MMO30085-86	-	Chordwise Coordinates

SECTION IV  
PROGRAM OUTPUT

A. Output for Each Option

In addition to all input data, the following is printed for each option.

1. Option 1 (for each dynamic pressure)
  - a. Deformation mode
  - b. Total deflection mode
  - c. Final aerodynamic force distribution
  - d. Total force distribution
2. Option 2 (for each dynamic pressure)
  - a. Incremental pitch angle
  - b. Deformation mode
  - c. Total deflection mode
  - d. Final aerodynamic force distribution
  - e. Total force distribution
3. Option 3 (for each dynamic pressure)
  - a. Aerodynamic lift
  - b. Incremental pitch angle
  - c. Deformation mode
  - d. Total deflection mode
  - e. Final aerodynamic force distribution
  - f. Total force distribution

4. Option 4 (divergence)
  - a. For each mode: mode number, eigenvalue, divergence pressure, and number of iterations
  - b. Divergence modes (eigenvectors)
  - c. Check eigenvalues
  - d. Check eigenvectors
5. Options 5, 6, 7, 8, and 9 (for each dynamic pressure)
  - a. Distributed force coefficients
  - b. Aerodynamic normal force, pitching moment, and rolling moment coefficients
  - c. Total chordwise center of pressure
  - d. Total spanwise center of pressure
  - e. For each strip: spanwise loading and local center of pressure.
6. Option 15 (for each dynamic pressure)
  - a. Corrected experimental force coefficients
  - b. Aerodynamic normal force, pitching moment, and rolling moment coefficients
  - c. Total chordwise center of pressure
  - d. Total spanwise center of pressure
  - e. For each strip: spanwise loading and local center of pressure.
7. Option 16 (for each dynamic pressure)
  - a. All data listed under the associated option (1, 2, or 3).
  - b. Shear, moment, and torque at load stations.

B. Example Printout

The printout for the example problem is shown on the following pages. Some of the results shown may be compared with similar calculations presented in Ref. 7.

# EXAMPLE PROBLEM - TRIMMED LOADS AND DIVERGENCE OPTIONS

01

## CONTROL ITEMS

(1)=-0 (2)= 1 (3)=-0 (4)= 2 (5)=-0 (6)=-0 (7)=-0 (8)=-0 (9)=-0  
(10)= 1 (11)=-0 (12)=-0 (13)=-0 (14)= 3 (15)=-0 (16)= 1 (17)=10 (18)= 1

CBAR 0.22455999E 03 NORM CONST 0.59559999E-07 CAPS 0.56423599E 03 Z -0.41919000E 05  
REF T 0.09999999E 01 REF N 0.50000000E 03 SMS 0.09999999E 01  
0. REF T 0.09999999E 01 REF N 0.50000000E 03 SMS 0.09999999E 01  
0. REF T 0.09999999E 01 REF N 0.50000000E 03 SMS 0.09999999E 01

REF H  
REF HO  
0.

0.40000000E 03 0.80000000E 03 0.12000000E 04  
3 DYNAMIC PRESSURES

## FLEXIBILITY MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	0.87171999E 02	0.13361000E 02	0.12778000E 03	0.62719999E 02	0.16250999E 03	0.10492200E 03
2	0.13361000E 02	0.30860999E 03	0.62719999E 02	0.32297000E 03	0.10492200E 03	0.33528999E 03
3	0.12778000E 03	0.62719999E 02	0.27732000E 03	0.15725999E 03	0.48255000E 03	0.37627999E 03
4	0.62719999E 02	0.32297000E 03	0.15725999E 03	0.63749000E 03	0.37627999E 03	0.80135999E 03
5	0.16250999E 03	0.10492200E 03	0.48255000E 03	0.37627999E 03	0.12757999E 04	0.11344299E 04
6	0.10492200E 03	0.33528999E 03	0.37627999E 03	0.80135999E 03	0.11344299E 04	0.16999000E 04
7	0.20478000E 03	0.15629999E 03	0.73283599E 03	0.64337999E 03	0.19350000E 04	0.18160000E 04
8	0.15629999E 03	0.35021000E 03	0.64337999E 03	0.10012100E 04	0.18160000E 04	0.22920000E 04
9	0.24285000E 03	0.20257000E 03	0.95810001E 03	0.88378000E 03	0.25283000E 04	0.24293999E 04
10	0.20402999E 03	0.35784999E 03	0.88378000E 03	0.11810599E 04	0.24293999E 04	0.28248999E 04

## COLUMN

	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10
1	0.20478000E 03	0.15629999E 03	0.24285000E 03	0.20402999E 03
2	0.15629999E 03	0.35021000E 03	0.20257000E 03	0.35784999E 03
3	0.73283599E 03	0.64337999E 03	0.95809998E 03	0.88378000E 03
4	0.64337999E 03	0.10012100E 04	0.88378000E 03	0.11810599E 04
5	0.19350000E 04	0.18160000E 04	0.25283000E 04	0.24293999E 04
6	0.18160000E 04	0.22920000E 04	0.24293999E 04	0.28248999E 04
7	0.36861999E 04	0.35051999E 04	0.52675000E 04	0.51171000E 04
8	0.35051999E 04	0.42291999E 04	0.51171000E 04	0.57186999E 04
9	0.52675000E 04	0.51171000E 04	0.84840000E 04	0.82340000E 04
10	0.51171000E 04	0.57186999E 04	0.82340000E 04	0.92340000E 04

AERODYNAMIC INFLUENCE COEFFICIENTS														REAL	1/KR =	0.
	COLUMN	1	COLUMN	2	COLUMN	3	COLUMN	4	COLUMN	5	COLUMN	6				
1	0.11040550E 01	-0.11040550E 01	0.44035111E-00	-0.44035111E-00	0.23558389E-00	-0.23558388E-00										
2	-0.65710617E-01	0.65710617E-01	0.29845583E-01	-0.29845580E-01	0.31780227E-01	-0.31780227E-01										
3	0.39277381E-00	-0.39277381E-00	0.98089795E 00	-0.98089795E 00	0.38376644E-00	-0.38376643E-00										
4	0.26774842E-01	-0.26774842E-01	-0.80031395E-01	0.80031425E-01	0.27342296E-01	-0.27342293E-01										
5	0.27598643E-00	-0.27598643E-00	0.27460741E-00	-0.27460741E-00	0.10764901E 01	-0.10764901E 01										
6	0.26934370E-02	-0.26934370E-02	0.29652580E-01	-0.29652578E-01	-0.86809320E-01	0.86809350E-01										
7	-0.32916859E-00	0.32916859E-00	0.48047283E-00	-0.48047283E-00	0.15607686E-00	-0.15607686E-00										
8	0.99114150E-01	-0.99114150E-01	0.50967707E 01	-0.50967722E-01	0.53080060E-01	-0.53080063E-01										
9	0.14902235E 01	-0.14902235E 01	-0.10267259E 01	0.10267299E 01	0.63286462E 00	-0.63286462E 00										
10	-0.29457279E-00	0.29457279E-00	0.21437690E-00	-0.21437693E-00	-0.98096674E-01	0.98096689E-01										

# COLUMN

COLUMN	7	8	9	10	COLUMN	1	2	3	4	5	6
1	0.15978687E-00	-0.15978687E-00	0.86297289E-01	-0.86297289E-01	COLUMN	1	2	3	4	5	6
2	0.19449846E-01	-0.19449846E-01	0.94341008E-02	-0.94341008E-02	COLUMN	1	2	3	4	5	6
3	0.19948611E-00	-0.19948611E-00	0.10024159E-00	-0.10024159E-00	COLUMN	1	2	3	4	5	6
4	0.26146957E-01	-0.26146957E-01	0.11618502E-01	-0.11618502E-01	COLUMN	1	2	3	4	5	6
5	0.38184877E-00	-0.38184877E-00	0.14753119E-00	-0.14753119E-00	COLUMN	1	2	3	4	5	6
6	0.32687288E-01	-0.32687288E-01	0.19040608E-01	-0.19040608E-01	COLUMN	1	2	3	4	5	6
7	0.12575267E 01	-0.12575267E 01	0.32880831E-00	-0.32880831E-00	COLUMN	1	2	3	4	5	6
8	-0.88885278E-01	0.88885278E-01	0.30007008E-01	-0.30007008E-01	COLUMN	1	2	3	4	5	6
9	0.92738150E-01	-0.92738150E-01	0.10493460E 01	-0.10493460E 01	COLUMN	1	2	3	4	5	6
10	0.48441701E-01	-0.48441701E-01	-0.819C1712E-01	0.81901712E-01	COLUMN	1	2	3	4	5	6

# WEIGHTING MATRIX

COLUMN	1	2	3	4	5	6
1	0.09959999E 01	0.	0.	0.	0.	0.
2	0.	0.09959999E 01	0.	0.	0.	0.
3	0.	0.	0.09559599E 01	0.	0.	0.
4	0.	0.	0.	0.09959999E 01	0.	0.
5	0.	0.	0.	0.	0.09959999E 01	0.
6	0.	0.	0.	0.	0.	0.09959999E 01
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.

	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10	COLUMN
1	0.	0.	0.	0.	
2	0.	0.	0.	0.	
3	0.	0.	0.	0.	
4	0.	0.	0.	0.	
5	0.	0.	0.	0.	
6	0.	0.	0.	0.	
7	0.0999999E 01	0.	0.	0.	
8	0.	0.0999999E 01	0.	0.	
9	0.	0.	0.0999999E 01	0.	
10	0.	0.	0.	0.0999999E 01	

INITIAL DEFLECTION MODE (H/REF HO)  
REAL

1	-0.
2	-0.
3	-0.
4	-0.
5	-0.
6	-0.
7	-0.
8	-0.
9	-0.
10	-0.

ADDITIONAL DEFLECTION MODE (H/REF H)  
REAL

1	0.
2	-0.
3	-0.
4	-0.
5	-0.
6	-0.
7	0.
8	-0.
9	-0.
10	-0.

MASS MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	0.53835999E 04	-0.13490000E 03	0.	0.	0.	0.
2	-0.13490000E 03	0.92519999E 03	0.	0.	0.	0.
3	0.	0.	0.20732000E 05	-0.11004999E 05	0.	0.
4	0.	0.	-0.11004999E 05	0.11477999E 05	0.	0.
5	0.	0.	0.	0.	0.31139000E 04	0.13970000E 03
6	0.	0.	0.	0.	0.13970000E 03	0.80660000E 03
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.

	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10
1	0.	0.	0.	0.
2	0.	0.	0.	0.
3	0.	0.	0.	0.
4	0.	0.	0.	0.
5	0.	0.	0.	0.
6	0.	0.	0.	0.
7	0.26387599E 04	-0.20999999E 02	0.	0.
8	-0.20555999E 02	0.80329999E 03	0.	0.
9	0.	0.	0.48750000E 03	0.72999999E 01
10	0.	0.	0.72559999E 01	0.17785999E 03

LOAD FACTOR MODE  
REAL

1	0.09999999E 01
2	0.09999999E 01
3	0.09999999E 01
4	0.09999999E 01
5	0.09999999E 01
6	0.09999999E 01
7	0.09999999E 01
8	0.09999999E 01
9	0.09999999E 01
10	0.09999999E 01

CHORDWISE COORDINATES  
REAL

1	0.2024999E 02
2	-0.8059599E 02
3	0.1785000E 02
4	-0.7139999E 02
5	0.1579999E 02
6	-0.6319999E 02
7	0.1329999E 02
8	-0.5320000E 02
9	0.1104999E 02
10	-0.4419999E 02

# SHEAR COEFFICIENT MATRIX

1 C COLUMN 1 COLUMN 2 COLUMN 3 COLUMN 4 COLUMN 5 COLUMN 6  
 0.05555599E 01 0.05555599E 01 0.05555599E 01 0.05555599E 01 0.05555599E 01 0.05555599E 01

1 C COLUMN 7 COLUMN 8 COLUMN 9 COLUMN 10 COLUMN  
 0.05555599E 01 0.05555599E 01 0.05555599E 01 0.05555599E 01 0.05555599E 01

# MOMENT COEFFICIENT MATRIX

1 C COLUMN 1 COLUMN 2 COLUMN 3 COLUMN 4 COLUMN 5 COLUMN 6  
 0.45000000E 02 0.45000000E 02 0.14100000E 03 0.14100000E 03 0.22300000E 03 0.22300000E 03

1 C COLUMN 7 COLUMN 8 COLUMN 9 COLUMN 10 COLUMN  
 0.32300000E 03 0.32300000E 03 0.41300000E 03 0.41300000E 03 0.41300000E 03

# TORQUE COEFFICIENT MATRIX

1 C COLUMN 1 COLUMN 2 COLUMN 3 COLUMN 4 COLUMN 5 COLUMN 6  
 -0.20255599E 02 0.80999999E 02 -0.17850000E 02 0.71399999E 02 -0.15799999E 02 0.63199999E 02

1 C COLUMN 7 COLUMN 8 COLUMN 9 COLUMN 10 COLUMN  
 -0.13255599E 02 0.53200000E 02 -0.11049999E 02 0.44199999E 02 0.44199999E 02

# LOADS FOR TRIMMED CONDITION

DYNAMIC PRESSURE = 0.4000000E 03

AERODYNAMIC LIFT (Z)= -0.41919000E 05

INCREMENTAL PITCH ANGLE = 0.46606336E-01

DEFORMATION MODE	TOTAL DEFLECTION MODE
1 -0.35778464E-00	1 -0.13015629E 01
2 -0.16302317E-00	2 0.36120900E 01
3 -0.12215040E 01	3 -0.20534271E 01
4 -0.91019940E 00	4 0.24174929E 01
5 -0.31506635E 01	5 -0.38870436E 01
6 -0.27622538E 01	6 0.18326655E-00
7 -0.60628324E 01	7 -0.66826966E 01
8 -0.55978061E 01	8 -0.31183490E 01
9 -0.92359689E 01	9 -0.97509689E 01
10 -0.86867576E 01	10 -0.66267575E 01

## FINAL AERODYNAMIC FORCE DISTRIBUTION

TOTAL FORCE DISTRIBUTION
1 -0.39714313E 04
2 0.75146689E 03
3 0.79779468E 03
4 0.45841973E 03
5 -0.55609780E 04
6 0.97793347E 03
7 -0.40783482E 04
8 0.52939943E 03
9 -0.84639199E 04
10 0.11596636E 04

SHEAR AT LOAD STATIONS

-0.17399999E 05

MOMENT AT LOAD STATIONS

-0.51527593E 07

TORQUE AT LOAD STATIONS

0.53663919E 06

# LOADS FOR TRIMMED CONDITION

DYNAMIC PRESSURE = 0.8000000E 03

AERODYNAMIC LIFT (Z)= -0.41919000E 05

INCREMENTAL PITCH ANGLE = 0.20981035E-01

DEFORMATION MODE	TOTAL DEFLECTION MODE
1 -0.36199015E-00	1 -0.78685611E 00
2 -0.16960739E-00	2 0.15298564E 01
3 -0.12451448E 01	3 -0.16196562E 01
4 -0.93552055E 00	4 0.56252537E 00
5 -0.32219631E 01	5 -0.35534634E 01
6 -0.28336892E 01	6 -0.15076878E 01
7 -0.62063475E 01	7 -0.64853952E 01
8 -0.57386997E 01	8 -0.46225086E 01
9 -0.94494957E 01	9 -0.96813361E 01
10 -0.88997614E 01	10 -0.79723996E 01

## FINAL AERODYNAMIC FORCE DISTRIBUTION

1 -0.89190357E 04	1 -0.36703358E 04
2 -0.60719352E 02	2 0.72958063E 03
3 -0.87839620E 04	3 0.94303796E 03
4 -0.23847163E 02	4 0.44915283E 03
5 -0.88358740E 04	5 -0.55822740E 04
6 0.26507911E 02	6 0.97280791E 03
7 -0.70411254E 04	7 -0.44233255E 04
8 -0.22606549E 03	8 0.55623450E 03
9 -0.89878254E 04	9 -0.84930255E 04
10 0.93294715E 03	10 0.11181471E 04

SHEAR AT LOAD STATIONS

-0.17356999E 05

MOMENT AT LOAD STATIONS

-0.52588411E 07

TORQUE AT LOAD STATIONS

0.53902992E 06

# LOADS FOR TRIMMED CONDITION

DYNAMIC PRESSURE = 0.1200000E 04

AERODYNAMIC LIFT (Z)= -0.4191900E 05

INCREMENTAL PITCH ANGLE = 0.12441241E-01

DEFORMATION MODE	TOTAL DEFLECTION MODE
1 -0.36626212E-00	1 -0.61819725E 00
2 -0.17629514E-00	2 0.83144537E 00
3 -0.12691572E 01	3 -0.14912333E 01
4 -0.96123845E 00	4 -0.72933845E-01
5 -0.32944059E 01	5 -0.34909774E 01
6 -0.29062601E 01	6 -0.21199737E 01
7 -0.63520887E 01	7 -0.65175571E 01
8 -0.58817549E 01	8 -0.52198808E 01
9 -0.96661822E 01	9 -0.98036578E 01
10 -0.91159250E 01	10 -0.85660221E 01

## FINAL AERODYNAMIC FORCE DISTRIBUTION

## TOTAL FORCE DISTRIBUTION

1 -0.86130322E 04	1 -0.33643322E 04
2 -0.82933617E 02	2 0.70736637E 03
3 -0.86355639E 04	3 0.10914361E 04
4 -0.33407719E 02	4 0.43959228E 03
5 -0.88578584E 04	5 -0.56042585E 04
6 0.21282013E 02	6 0.96758201E 03
7 -0.73939513E 04	7 -0.47761513E 04
8 -0.19848777E 03	8 0.58381222E 03
9 -0.90156926E 04	9 -0.85208927E 04
10 0.89064544E 03	10 0.10758454E 04

## SHEAR AT LOAD STATIONS

-0.17399999E 05

## MOMENT AT LOAD STATIONS

-0.53665973E 07

## TORQUE AT LOAD STATIONS

0.52331747E 06

# DIVERGENCE OPTION

MCDE	LAMBDA	DIVERGENT Q	NO. ITERATIONS
1	0.10533979E 04	0.37855525E 04	7
2	0.14795922E 03	0.26951299E 05	17

MODAL COLUMNS NORMALIZED ON THE LARGEST ELEMENT

## COLUMN 2

1	0.46074241E-01
2	0.30984621E-01
3	0.14665693E-00
4	0.12125430E-00
5	0.36689373E-00
6	0.33670042E-00
7	0.67907555E 00
8	0.64371622E 00
9	0.09999999E 01
10	0.96211223E 00

## CHECK EIGENVALUES AND EIGENVECTORS

### COLUMN

1	0.10533956E 04
2	0.14795691E 03

### COLUMN 2

1	0.46074230E-01
2	0.30984621E-01
3	0.14665692E-00
4	0.12125429E-00
5	0.36689373E-00
6	0.33670041E-00
7	0.67907548E 00
8	0.64371625E 00
9	0.09999999E 01
10	0.96211215E 00

# EXAMPLE PROBLEM - AERODYNAMIC STABILITY AND INERTIAL DERIVATIVES

01

## CONTROL ITEMS

(1)=-0 (2)=-0 (3)=-0 (4)=-0 (5)=-0 (6)= 1 (7)=-0 (8)=-0 (9)= 1  
(10)= 1 (11)=-0 (12)=-0 (13)=-0 (14)= 4 (15)=-0 (16)=-0 (17)=10 (18)= 1

REF M  
0.0999999E 01

Z

REF H0  
0.

CAPS

-0.41919000E 05

NORM CONST

0.9999999E-07

CBAR

0.2249999E 03

X0

0.

SMS

0.500C0000E 03

REF N

0.05955599E 01

REF T

0.

## 4 DYNAMIC PRESSURES

0. 0.40000000E 03 0.80000000E 03 0.12000000E 04

## FLEXIBILITY MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	0.87171999E 02	0.13361000E 02	0.12778CC0E 03	0.62719999E 02	0.16250999E 03	0.10492200E 03
2	0.13361C00E 02	0.30860999E 03	0.62719999E 02	0.32297C00E 03	0.10492200E 03	0.33528999E 03
3	0.12778CC0E 03	0.62719999E 02	0.27732000E 03	0.15725999E 03	0.48255000E 03	0.37627999E 03
4	0.62719999E 02	0.32297000E 03	0.15725999E 03	0.63749C00E 03	0.37627999E 03	0.80135999E 03
5	0.16250999E 03	0.10492200E 03	0.48255000E 03	0.37627999E 03	0.12757999E 04	0.11344299E 04
6	0.10492200E 03	0.33528999E 03	0.37627999E 03	0.80135999E 03	0.11344299E 04	0.16999000E 04
7	0.20478C00E 03	0.15629999E 03	0.73283999E 03	0.64337999E 03	0.19350000E 04	0.18160000E 04
8	0.15625999E 03	0.35021000E 03	0.64337999E 03	0.10012100E 04	0.18160000E 04	0.22920000E 04
9	0.24285C00E 03	0.20257000E 03	0.95810001E 03	0.88378000E 03	0.25283000E 04	0.24293999E 04
10	0.20402999E 03	0.35784999E 03	0.88378CC0E 03	0.11810599E 04	0.24293999E 04	0.28248999E 04

## COLUMN

10

COLUMN 9

COLUMN 8

COLUMN 7

1	0.20478C00E 03	0.15629999E 03	0.24285C00E 03	0.20402599E 03	0.20402599E 03
2	0.15625999E 03	0.35021000E 03	0.20257000E 03	0.35784999E 03	0.35784999E 03
3	0.73283999E 03	0.64337999E 03	0.95809998E 03	0.88378000E 03	0.88378000E 03
4	0.64337999E 03	0.10012100E 04	0.88378CC0E 03	0.11810599E 04	0.11810599E 04
5	0.19350000E 04	0.18160000E 04	0.25283000E 04	0.24293999E 04	0.24293999E 04
6	0.18160000E 04	0.22920000E 04	0.24293999E 04	0.28248999E 04	0.28248999E 04
7	0.36861999E 04	0.35051999E 04	0.52675000E 04	0.51171000E 04	0.51171000E 04
8	0.35051999E 04	0.42291999E 04	0.51171000E 04	0.57186999E 04	0.57186999E 04
9	0.52675C00E 04	0.51171000E 04	0.84840000E 04	0.82340000E 04	0.82340000E 04
10	0.51171000E 04	0.57186999E 04	0.82340000E 04	0.92340000E 04	0.92340000E 04

AERODYNAMIC INFLUENCE COEFFICIENTS						REAL	1/KR =	0.
COLUMN	1	2	3	4	5	COLUMN	6	
1	0.11040550E-01	-0.11040550E-01	0.44035111E-00	-0.44035111E-00	0.23558389E-00	-0.23558388E-00		
2	-0.65710617E-01	0.65710617E-01	0.29845583E-01	-0.29845580E-01	0.31780227E-01	-0.31780227E-01		
3	0.39277381E-00	-0.39277381E-00	0.98089795E-00	-0.98089795E-00	0.38376644E-00	-0.38376643E-00		
4	0.26774842E-01	-0.26774842E-01	-0.80031395E-01	0.80031425E-01	0.27342296E-01	-0.27342293E-01		
5	0.27598643E-00	-0.27598643E-00	0.27460741E-00	-0.27460741E-00	0.10764901E-01	-0.10764901E-01		
6	0.26934370E-02	-0.26934370E-02	0.29652580E-01	-0.29652578E-01	-0.86809320E-01	0.86809350E-01		
7	-0.32916859E-00	0.32916859E-00	0.48047283E-00	-0.48047283E-00	0.15607686E-00	-0.15607686E-00		
8	0.89114150E-01	-0.89114150E-01	-0.50967707E-01	0.50967722E-01	0.53080060E-01	-0.53080063E-01		
9	0.14902235E-01	-0.14902235E-01	-0.10267299E-01	0.10267299E-01	3.63286462E-00	-0.63286462E-00		
10	-0.29457279E-00	0.29457279E-00	0.21437690E-00	-0.21437693E-00	-0.98096674E-01	0.98096689E-01		

COLUMN

COLUMN	7	8	9	10
1	0.15978687E-00	-0.15978687E-00	0.86297289E-01	-0.86297289E-01
2	0.19449846E-01	-0.19449846E-01	0.94341008E-02	-0.94341008E-02
3	0.19948611E-00	-0.19948611E-00	0.10024159E-00	-0.10024159E-00
4	0.28146957E-01	-0.28146957E-01	0.11618502E-01	-0.11618502E-01
5	0.38184877E-00	-0.38184877E-00	0.14753119E-00	-0.14753119E-00
6	0.32687288E-01	-0.32687288E-01	0.19040608E-01	-0.19040608E-01
7	0.12575267E-01	-0.12575267E-01	0.32880831E-00	-0.32880831E-00
8	-0.88885278E-01	0.88885278E-01	0.30007008E-01	-0.30007008E-01
9	0.86738150E-01	-0.86738150E-01	0.10493460E-01	-0.10493460E-01
10	0.48441701E-01	-0.48441701E-01	0.81901712E-01	-0.81901712E-01

WEIGHTING MATRIX

COLUMN	1	2	3	4	5	COLUMN	6
1	0.09959999E-01	0.	0.	0.	0.	0.	
2	0.	0.09959999E-01	0.	0.	0.	0.	
3	0.	0.	0.09599599E-01	0.	0.	0.	
4	0.	0.	0.	0.09999999E-01	0.	0.	
5	0.	0.	0.	0.	0.09999999E-01	0.	
6	0.	0.	0.	0.	0.	0.09999999E-01	
7	0.	0.	0.	0.	0.	0.	
8	0.	0.	0.	0.	0.	0.	
9	0.	0.	0.	0.	0.	0.	
10	0.	0.	0.	0.	0.	0.	

	COLUMN 7	COLUMN 8	COLUMN 9	COLUMN 10	COLUMN
1	0.	0.	0.	0.	
2	0.	0.	0.	0.	
3	0.	0.	0.	0.	
4	0.	0.	0.	0.	
5	0.	0.	0.	0.	
6	0.	0.	0.	0.	
7	0.05599999E 01	0.	0.	0.	
8	0.	0.09999999E 01	0.	0.	
9	0.	0.	0.09999999E 01	0.	
10	0.	0.	0.	0.09999999E 01	

ADDITIONAL DEFLECTION MODE (H/REF H)  
REAL

- 1 -0.35343000E-00
- 2 0.14137100E 01
- 3 -0.31151999E-00
- 4 0.12461600E 01
- 5 -0.27575999E-00
- 6 0.11030400E 01
- 7 -0.23213000E-00
- 8 0.92851000E 00
- 9 -0.19286000E-00
- 10 0.77142999E 00

MASS MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	0.53835999E 04	-0.13490000E 03	0.	0.	0.	0.
2	-0.13490000E 03	0.92519999E 03	0.	0.	0.	0.
3	0.	0.	0.20732000E 05	-0.11004999E 05	0.	0.
4	0.	0.	-0.11004999E 05	0.11477999E 05	0.	0.
5	0.	0.	0.	0.	0.31139000E 04	0.13970000E 03
6	0.	0.	0.	0.	0.13970000E 03	0.80660000E 03
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.

1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.
7	0.26387599E 04	-0.20999999E 02	0.	0.	0.
8	-0.20999999E 02	0.80329999E 03	0.	0.48750000E 03	0.72999999E 01
9	0.	0.	0.	0.72999999E 01	0.17785999E 03
10	0.	0.	0.	0.	0.

LOAD FACTOR MODE  
REAL

1	0.09999999E 01
2	0.09999999E 01
3	0.09999999E 01
4	0.09999999E 01
5	0.09999999E 01
6	0.09999999E 01
7	0.09999999E 01
8	0.09999999E 01
9	0.09999999E 01
10	0.09999999E 01

CHORDWISE COORDINATES  
REAL

1	0.20249999E 02
2	-0.80999999E 02
3	0.17850000E 02
4	-0.71399999E 02
5	0.15799999E 02
6	-0.63199999E 02
7	0.13299999E 02
8	-0.53200000E 02
9	0.11049999E 02
10	-0.44199999E 02

SPANWISE COORDINATES  
REAL

1	0.9000000E 02
2	0.9000000E 02
3	0.1860000E 03
4	0.1860000E 03
5	0.2680000E 03
6	0.2680000E 03
7	0.3680000E 03
8	0.3680000E 03
9	0.4580000E 03
10	0.4580000E 03

# INPUT DATA FOR LOAD DISTRIBUTION CALCULATIONS

## 5 STRIPS

STRIP	CONTROL POINTS
1	2
2	2
3	2
4	2
5	2

STRIP	DELTA Y(I)	CHORDWISE CONTROL POINT LOCATIONS (PERCENT CHORD)
1	0.9300000E 02	0.2500000E-00 0.7500000E 00
2	0.8900000E 02	0.2500000E-00 0.7500000E 00
3	0.9100000E 02	0.2500000E-00 0.7500000E 00
4	0.9500000E 02	0.2500000E-00 0.7500000E 00
5	0.8700000E 02	0.2500000E-00 0.7500000E 00

# AERODYNAMIC STABILITY DERIVATIVES

\*\*\*\*\*DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0. REAL

1	-0.14357547E-01
2	-0.26047353E-04
3	-0.13686051E-01
4	-0.84458637E-05
5	-0.13267461E-01
6	0.55308361E-04
7	-0.95935404E-02
8	-0.42095377E-03
9	-0.13470409E-01
10	0.15316699E-02

## AERODYNAMIC COEFFICIENTS

CZ = -0.63243476E-01 CM = 0.47430755E-02 CL = -0.33071665E-01

TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-XO)/CBAR = 0.74997071E-01

TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.52292612E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	0.77331154E-01	0.25090545E-00
2	0.76935378E-01	0.25030836E-00
3	0.72594246E-01	0.24790691E-00
4	0.52707863E-01	0.27101722E-00
5	0.68613441E-01	0.18585294E-00

\*\*\*\*\*DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.40000000E 03) REAL

1	-0.15553647E-01
2	-0.70288702E-04
3	-0.15114766E-01
4	-0.21486091E-04
5	-0.14917786E-01
6	0.54172933E-04
7	-0.11358085E-01

8 -0.42172892E-03  
 9 -0.15051256E-01  
 10 0.16281382E-02  
 AERODYNAMIC COEFFICIENTS  
 CZ = -0.70826732E-01 CM = 0.52602834E-02 CL = -0.37375409E-01  
 TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-XO)/CBAR = 0.74269747E-01  
 TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.52770201E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	0.8399655E-01	0.25224939E-00
2	0.85035121E-01	0.25070975E-00
3	0.81668207E-01	0.24817766E-00
4	0.61999021E-01	0.26790049E-00
5	0.7714355E-01	0.18935320E-00

\*\*\*\*\*DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.80000000E 03)  
REAL

1 -0.17061824E-01  
 2 -0.12706977E-03  
 3 -0.16922084E-01  
 4 -0.38488138E-04  
 5 -0.17013357E-01  
 6 0.52667091E-04  
 7 -0.13610871E-01  
 8 -0.42118333E-03  
 9 -0.17049915E-01  
 10 0.17485712E-02

AERODYNAMIC COEFFICIENTS  
 CZ = -0.80443554E-01 CM = 0.59154046E-02 CL = -0.42837886E-01  
 TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-XO)/CBAR = 0.73534849E-01  
 TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.53252105E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	-0.41379851E-02	0.26184864E-00
2	-0.49220639E-02	0.24625484E-00
3	-0.47957923E-02	0.24737089E-00
4	-0.40459378E-02	0.25357463E-00
5	-0.31583379E-02	0.21799854E-00

\*\*\*\*\*DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.12000000E 04)  
REAL

1	0.84211492E-03
2	0.21670499E-04
3	0.99198898E-03
4	-0.56417739E-05
5	0.10039362E-02
6	-0.46560635E-05
7	0.89774501E-03
8	0.52784889E-05
9	0.69878040E-03
10	-0.41836873E-04

# AERODYNAMIC COEFFICIENTS

CZ = 0.44093797E-02 CM = -0.31463867E-03 CL = 0.23244022E-02

TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/CBAR = 0.713566674E-01

TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.52714948E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	-0.46440070E-02	0.26254391E-00
2	-0.55412764E-02	0.24714006E-00
3	-0.54905503E-02	0.24767029E-00
4	-0.47527552E-02	0.25292267E-00
5	-0.37755375E-02	0.21815793E-00

# INERTIAL DERIVATIVES

\*\*\*\*\*DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.  
REAL

1	0.62580293E-03
2	0.13604192E-04
3	0.73171273E-03
4	-0.77137574E-05
5	0.70380675E-03
6	-0.44100925E-05
7	0.58094388E-03
8	0.56954086E-05
9	0.43050759E-03
10	-0.26081324E-04

# AERODYNAMIC COEFFICIENTS

CZ = 0.30538682E-02 CM = -0.22184324E-03 CL = 0.15615184E-02

TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-XO)/CBAR = 0.72643355E-01

TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.51132476E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	-0.34376726E-02	0.26063813E-00
2	-0.40674099E-02	0.24467281E-00
3	-0.38428387E-02	0.24684721E-00
4	-0.30875752E-02	0.25485426E-00
5	-0.23242888E-02	0.21775515E-00

\*\*\*\*\*DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.40000000E 03)  
REAL

1	0.68150777E-03
2	0.15638322E-04
3	0.79858477E-03
4	-0.72253242E-05
5	0.78050370E-03
6	-0.45051783E-05
7	0.66105811E-03

8 0.56248754E-05  
9 0.49821869E-03  
10 -0.30087743E-04

# AERODYNAMIC COEFFICIENTS

CZ = 0.33993179E-02 CM = -0.24555183E-03 CL = 0.17552938E-02

TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/CBAR = 0.72235616E-01

TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.51636646E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	-0.37480972E-02	0.26121596E-00
2	-0.44458395E-02	0.24543487E-00
3	-0.42637280E-02	0.24709717E-00
4	-0.35088578E-02	0.25421855E-00
5	-0.26904077E-02	0.21786396E-00

\*\*\*\*\*DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.80000000E 03)  
REAL

1 0.75142628E-03  
2 0.18238975E-04  
3 0.88268986E-03  
4 -0.65624736E-05  
5 0.87742376E-03  
6 -0.45895430E-05  
7 0.76323235E-03  
8 0.54958509E-05  
9 0.58472366E-03  
10 -0.35172852E-04

# AERODYNAMIC COEFFICIENTS

CZ = 0.38369058E-02 CM = -0.27551733E-03 CL = 0.20014707E-02

TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/CBAR = 0.71807165E-01

TOTAL SPANWISE CENTER OF PRESSURE YBAR/S = 0.52163664E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	0.92413411E-01	0.25369627E-00
2	0.95286114E-01	0.25113463E-00
3	0.93190604E-01	0.24844737E-00
4	0.73852917E-01	0.26500790E-00
5	0.87938758E-01	0.19286216E-00

\*\*\*\*\*DISTRIBUTED FORCE COEFFICIENTS (DYNAMIC PRESSURE = 0.12000000E 04)  
REAL

1	-0.19026747E-01
2	-0.20222989E-03
3	-0.19283674E-01
4	-0.61302655E-04
5	-0.19760993E-01
6	0.50624304E-04
7	-0.16578963E-01
8	-0.41865196E-03
9	-0.19659936E-01
10	0.19040231E-02

AERODYNAMIC COEFFICIENTS

CZ = -0.93037850E-01      CM = 0.67724387E-02      CL = -0.49996965E-01  
TOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/CBAR = 0.72792295E-01  
TOTAL SPANWISE CENTER OF PRESSURE      YBAR/S = 0.53738306E 00

STRIP	CLC/CAVE	LOCAL CHORDWISE CP
1	0.10338160E-00	0.25525846E-00
2	0.10867964E-00	0.25158446E-00
3	0.10829873E-00	0.24871579E-00
4	0.89461129E-01	0.26231502E-00
5	0.10204548E-00	0.19638340E-00

## SECTION V

### PROCESSING INFORMATION

#### A. Operation

FORTRAN II MONITOR system

#### B. Estimated Machine Time

Because of the number of variables involved such as options, order of system, number of dynamic pressures, etc., it is not possible to give a practical method of estimating machine time. When the data are appropriate, considerable time may be saved by performing as many options as possible in one machine pass. Also, complete but independent data decks may be stacked to save program read-in time.

#### C. Machine Components Used

About 26,000 core storages

Standard FORTRAN input tape (NTAPE2)

Standard FORTRAN output print tape (NTAPE3)

Four utility tapes (NTAPE4, NTAPE5, NTAPE6, NTAPE8)

## SECTION VI

### PROGRAM NOTES

#### A. Subroutines Used

In addition to the main program (page 77) the following subprograms were used.

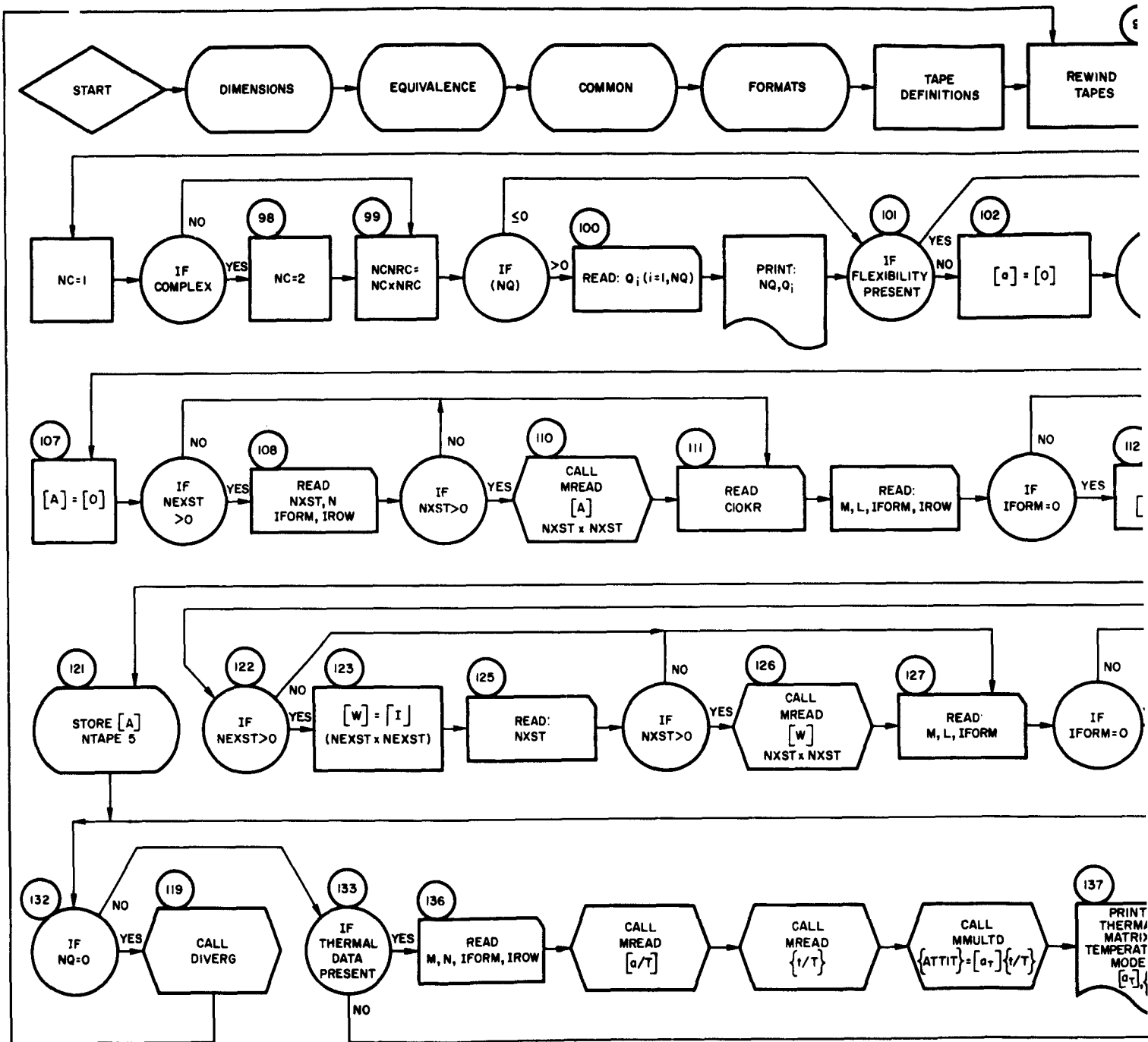
1. MPRINT, prints matrix in matrix format (page 91).
2. MMULTD, computes the product  $[C]$  of the two matrices  $[A]$  and  $[B]$  (page 95).
3. MREAD, reads a matrix in either column binary or FORTRAN format (page 98).
4. BINRD, reads column binary cards (page 103).
5. RDLN, reads and prints title card (page 113).
6. MNVRSX, computes the inverse of a complex matrix (page 115).
7. INVERS, computes the inverse of a real matrix (page 118).
8. SWEEPX, computes true mode and sweeps it from the related matrix (page 123).
9. CENTER, computes the aerodynamic coefficients, centers of pressure, and spanwise loadings (page 128).
10. LOADS, computes the three loads options and the structural loads suboption (page 133).
11. DERIV, computes the flexible load coefficients used in the derivative options (page 143).
12. MITER, matrix iteration (page 149).
13. NPNRMX, vector normalization (page 160).
14. DIVERG, divergent pressure calculations (page 165).

B. Generalized Tapes

Input, print, and utility tapes in this coding are defined as logical units 2, 3, 5, 6, 7, and 8; however, these may be altered by placing the desired units on symbolic cards HMO3O827 through HMO3O832 in the main program.

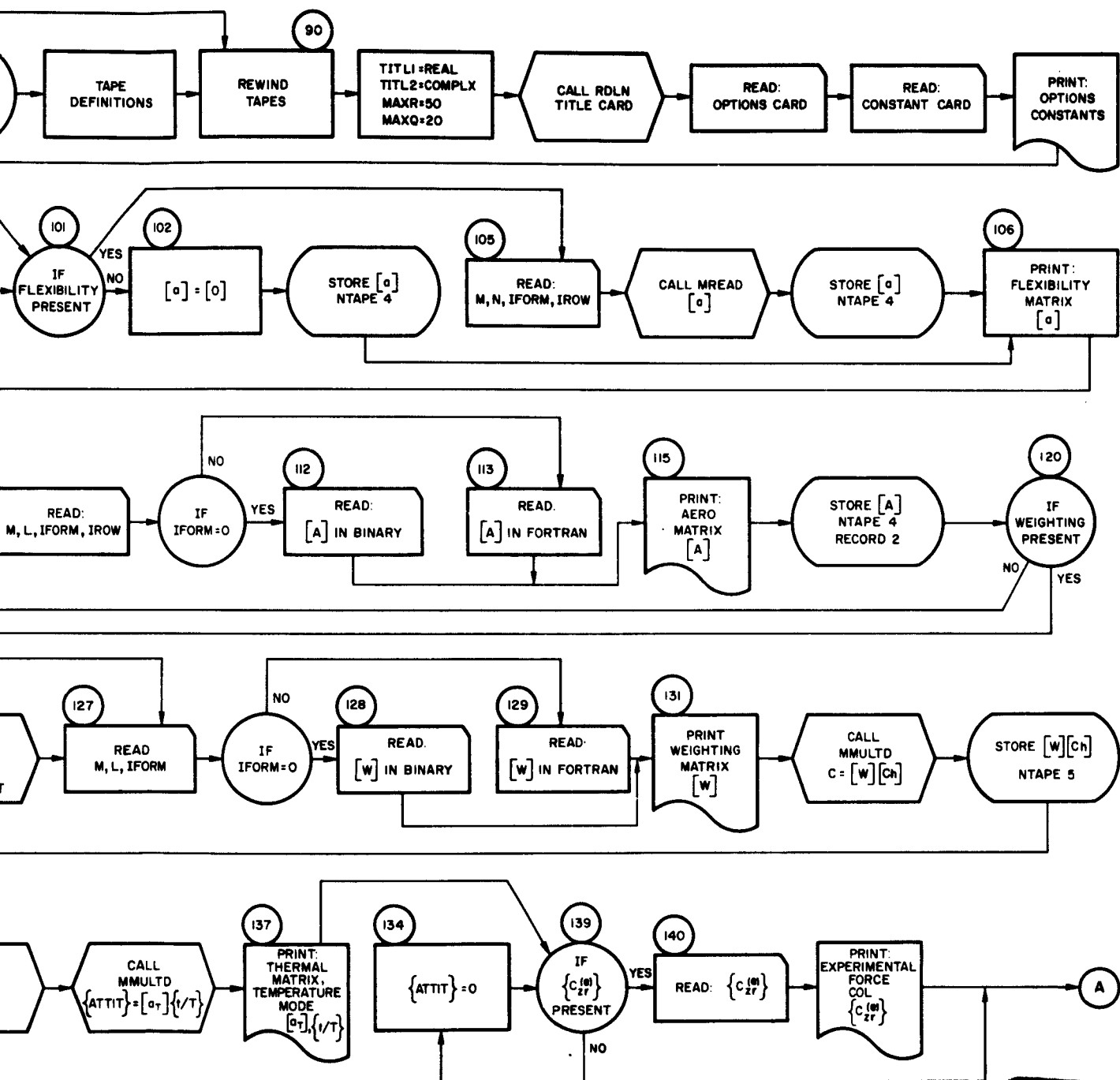
SECTION VII  
FLOW DIAGRAMS

# FLOW DIAGRAM - MAIN PROGRAM

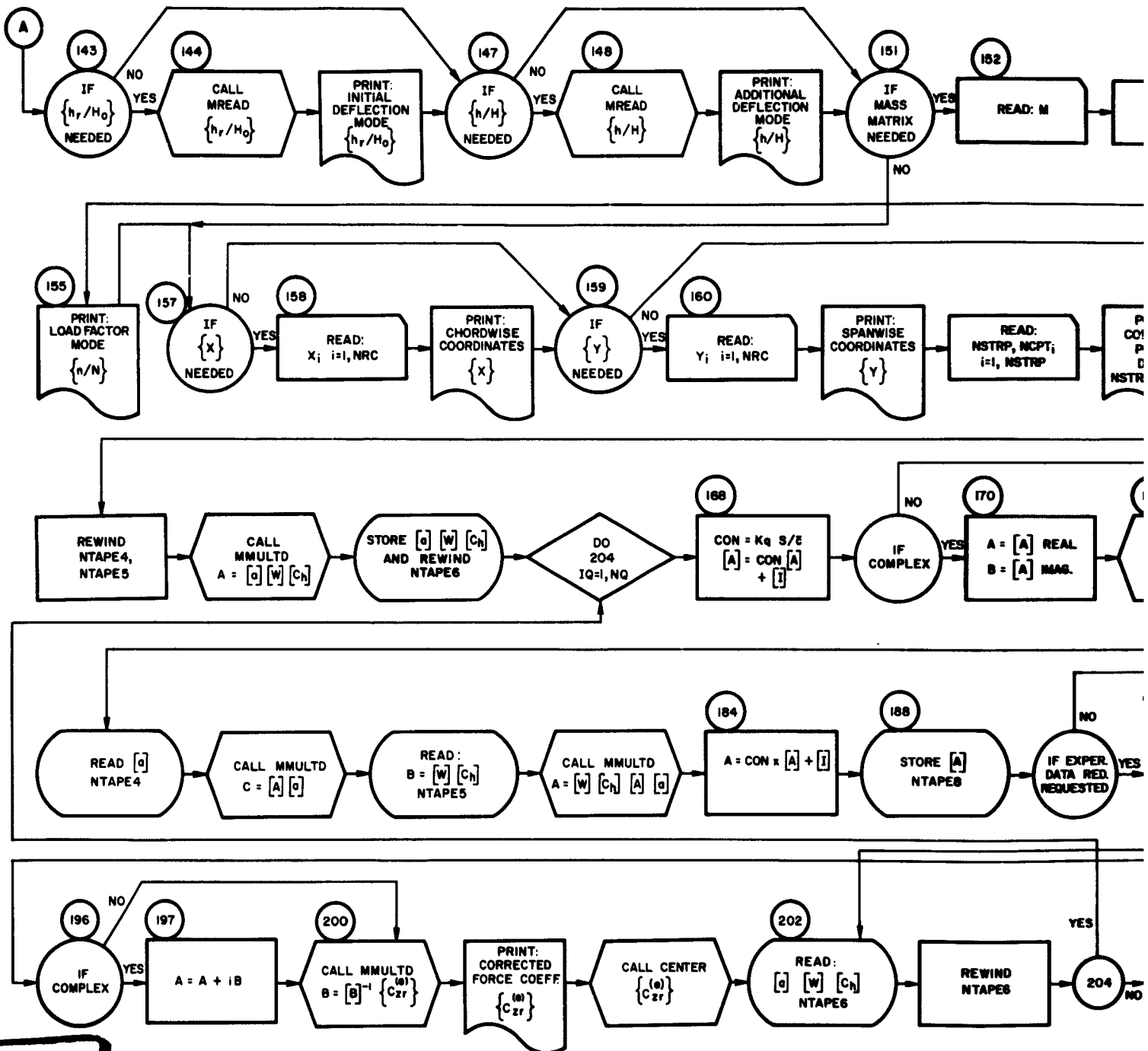


1

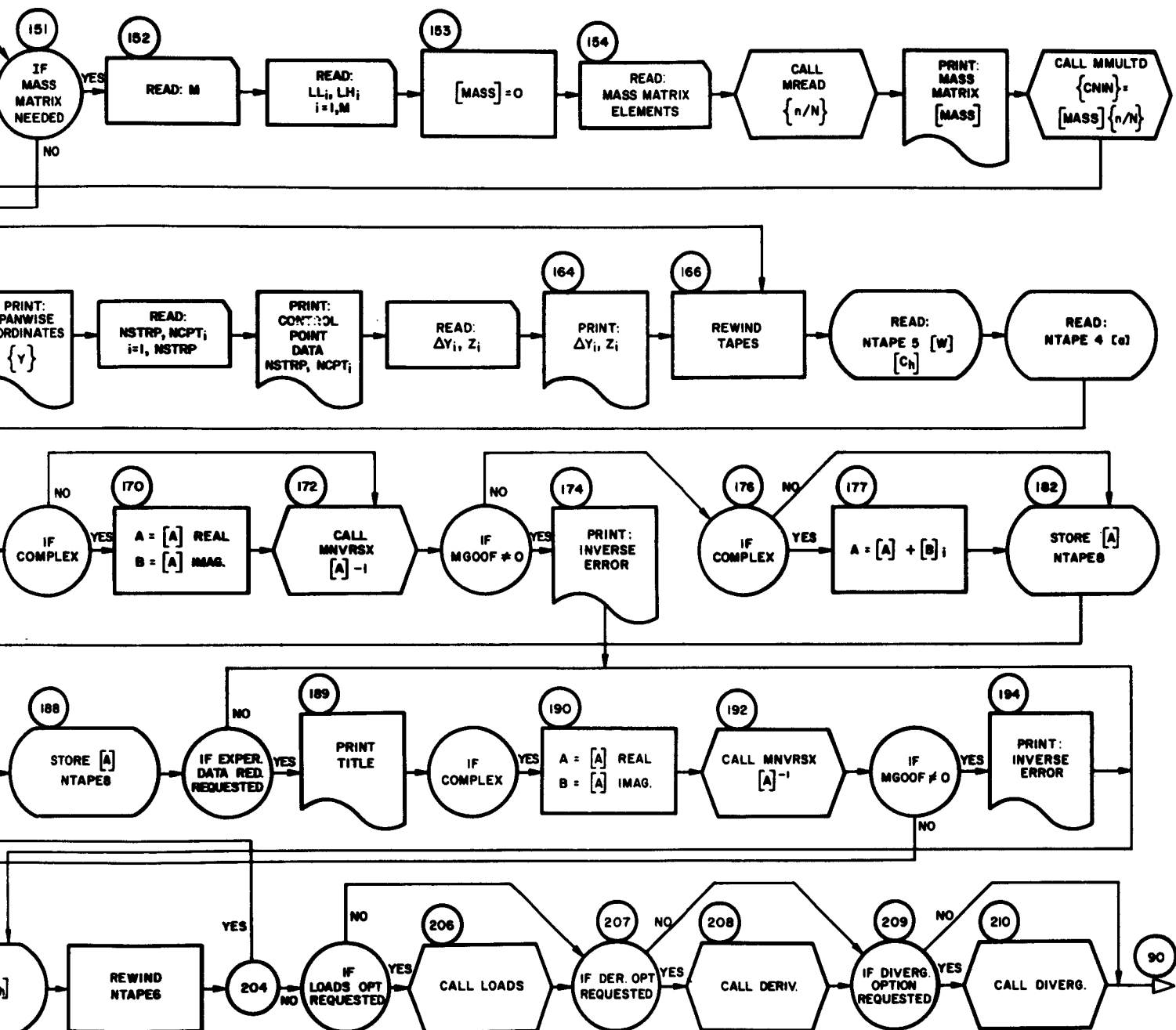
# GRAM - MAIN PROGRAM



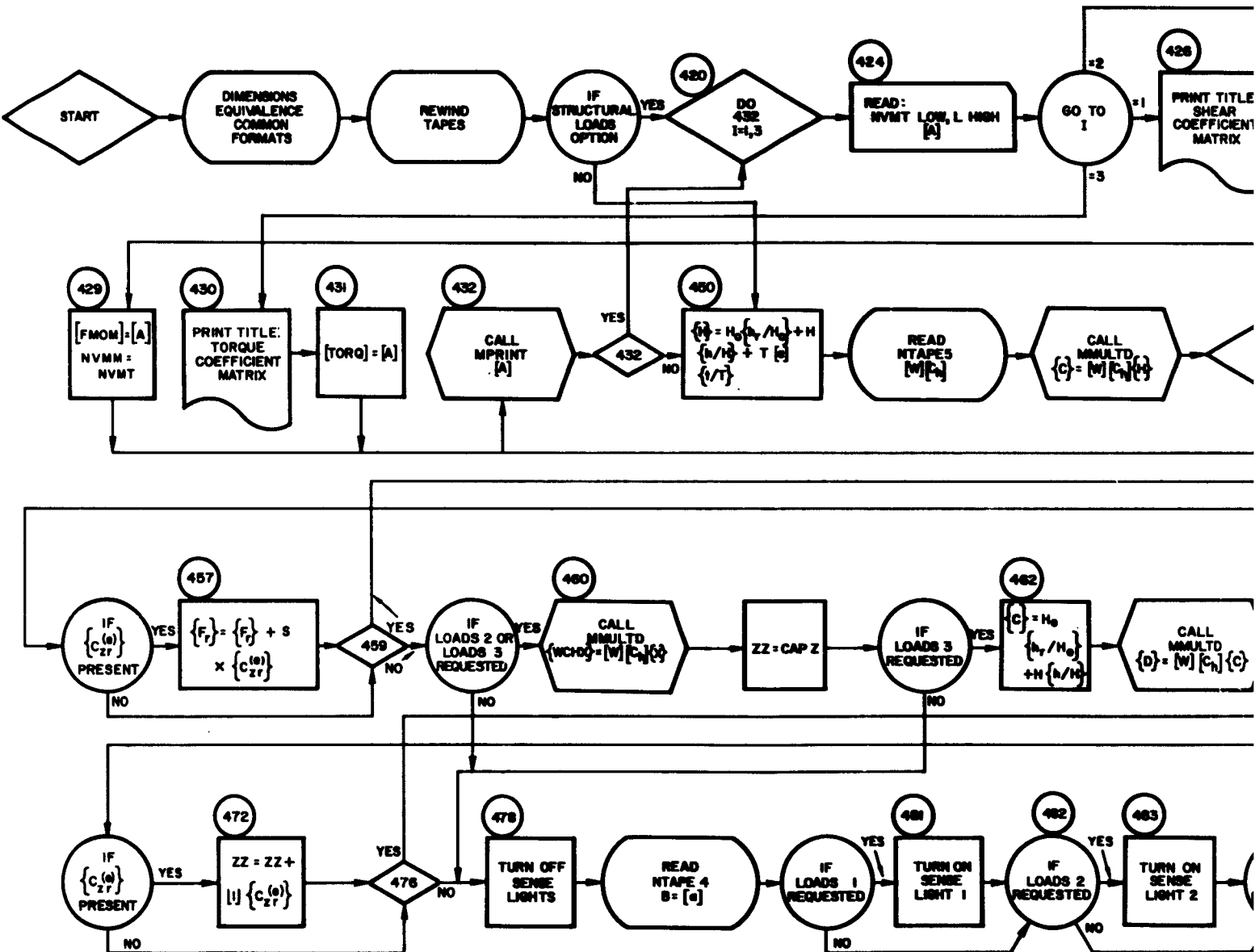
# FLOW DIAGRAM — MAIN PROGRAM



# RAM — MAIN PROGRAM (CONTINUED)

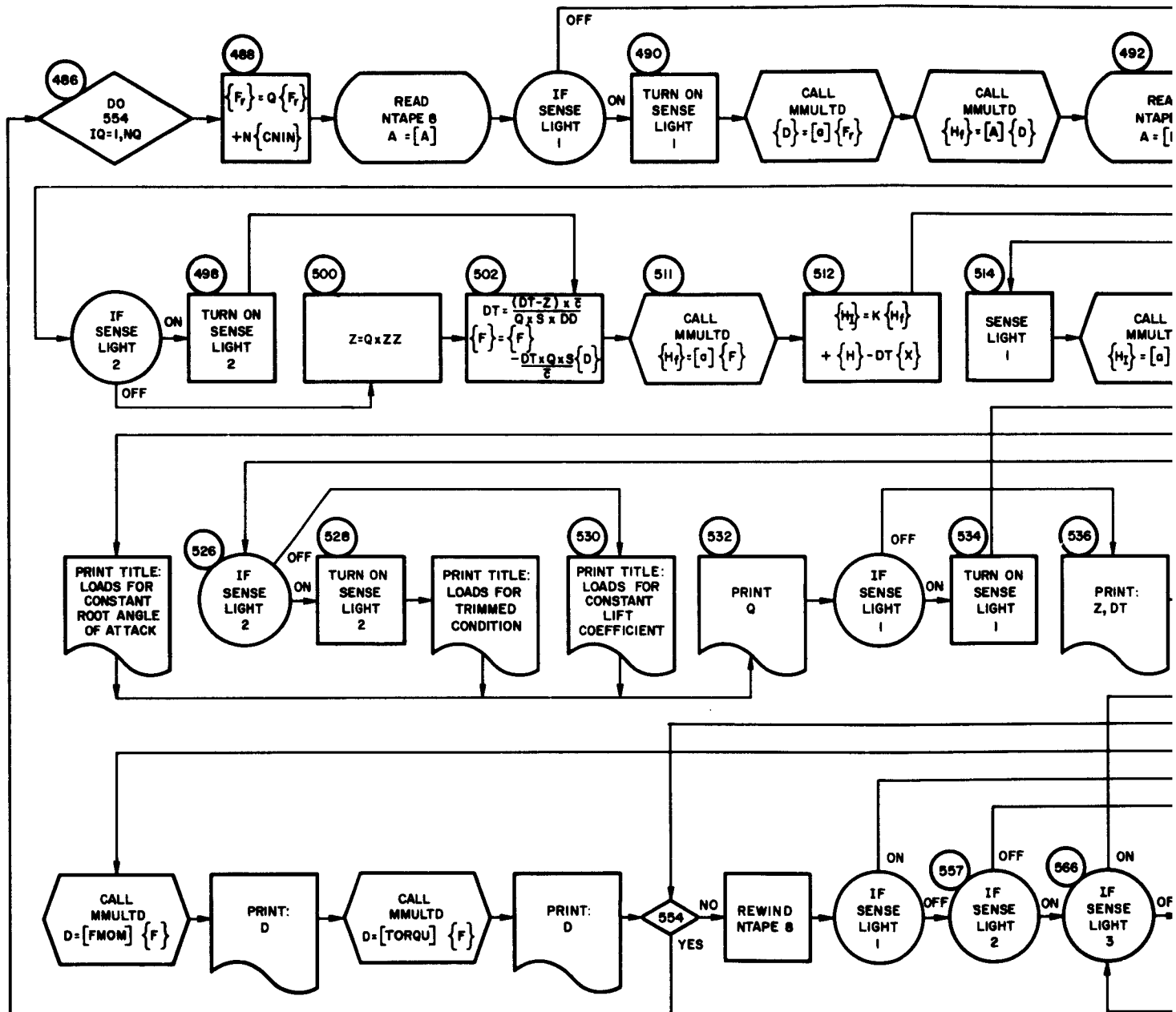


# FLOW DIAGRAM - LOADS SUBROUTINE

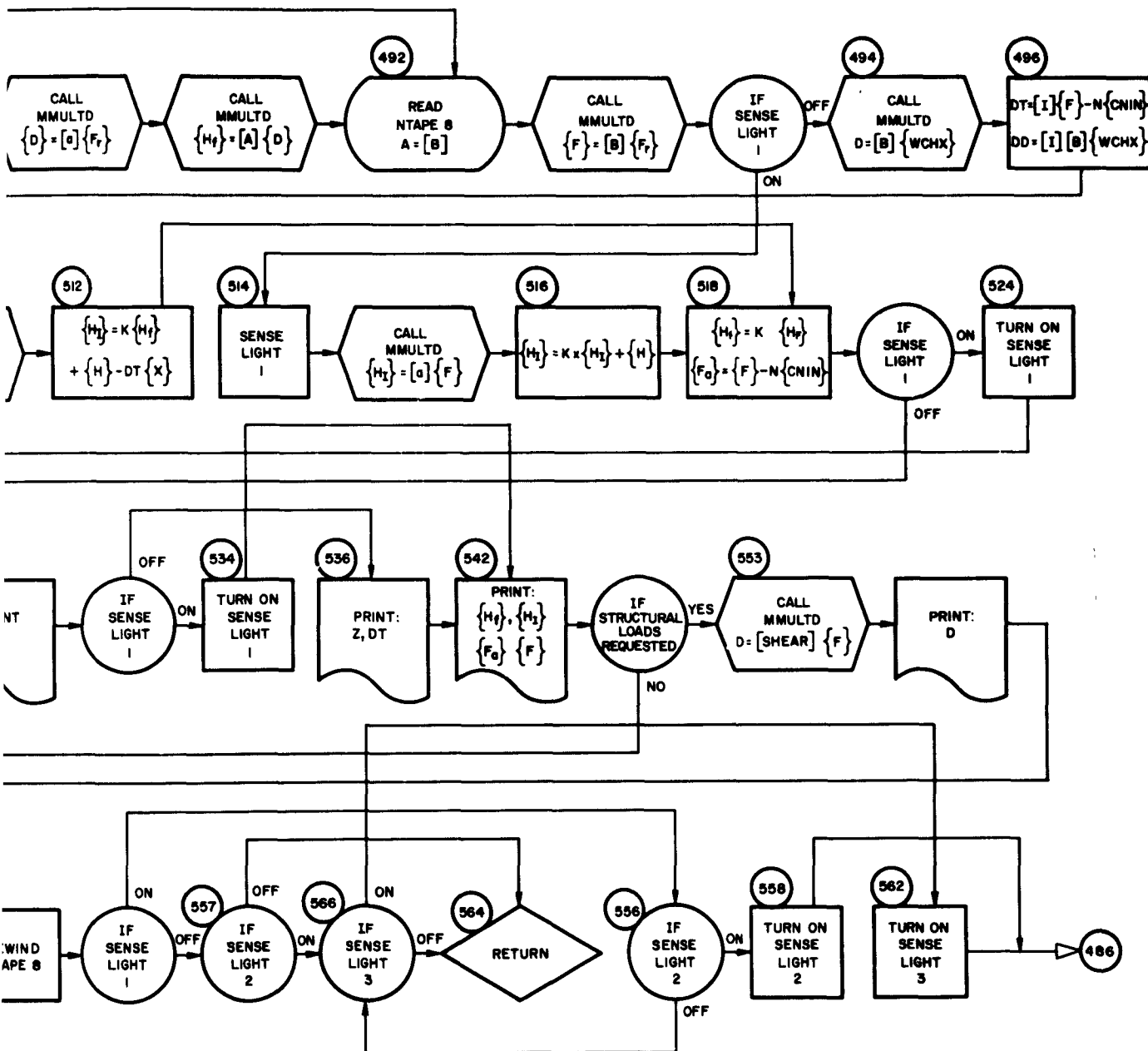


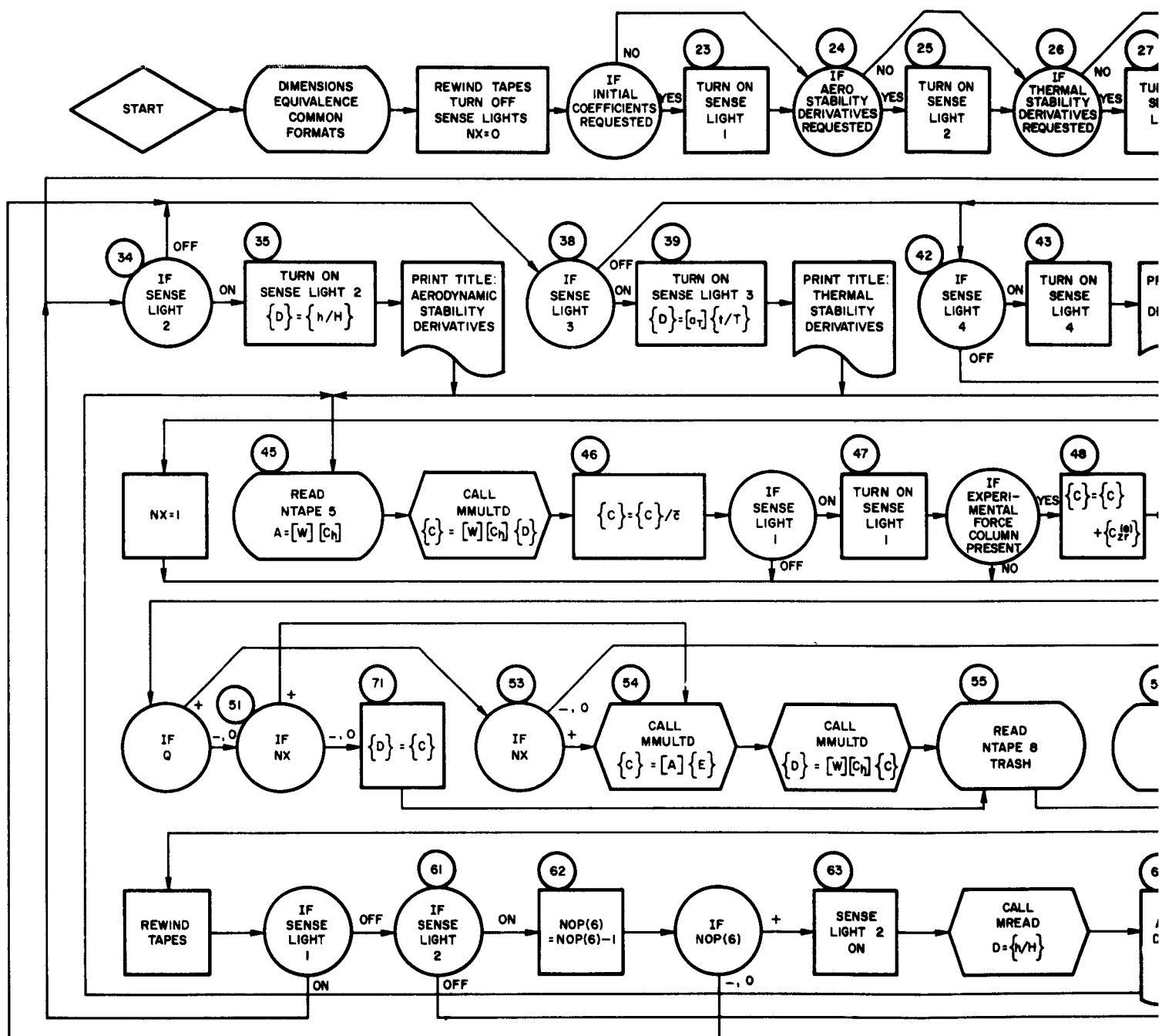


# FLOW DIAGRAM - LOADS SUBROUTINE

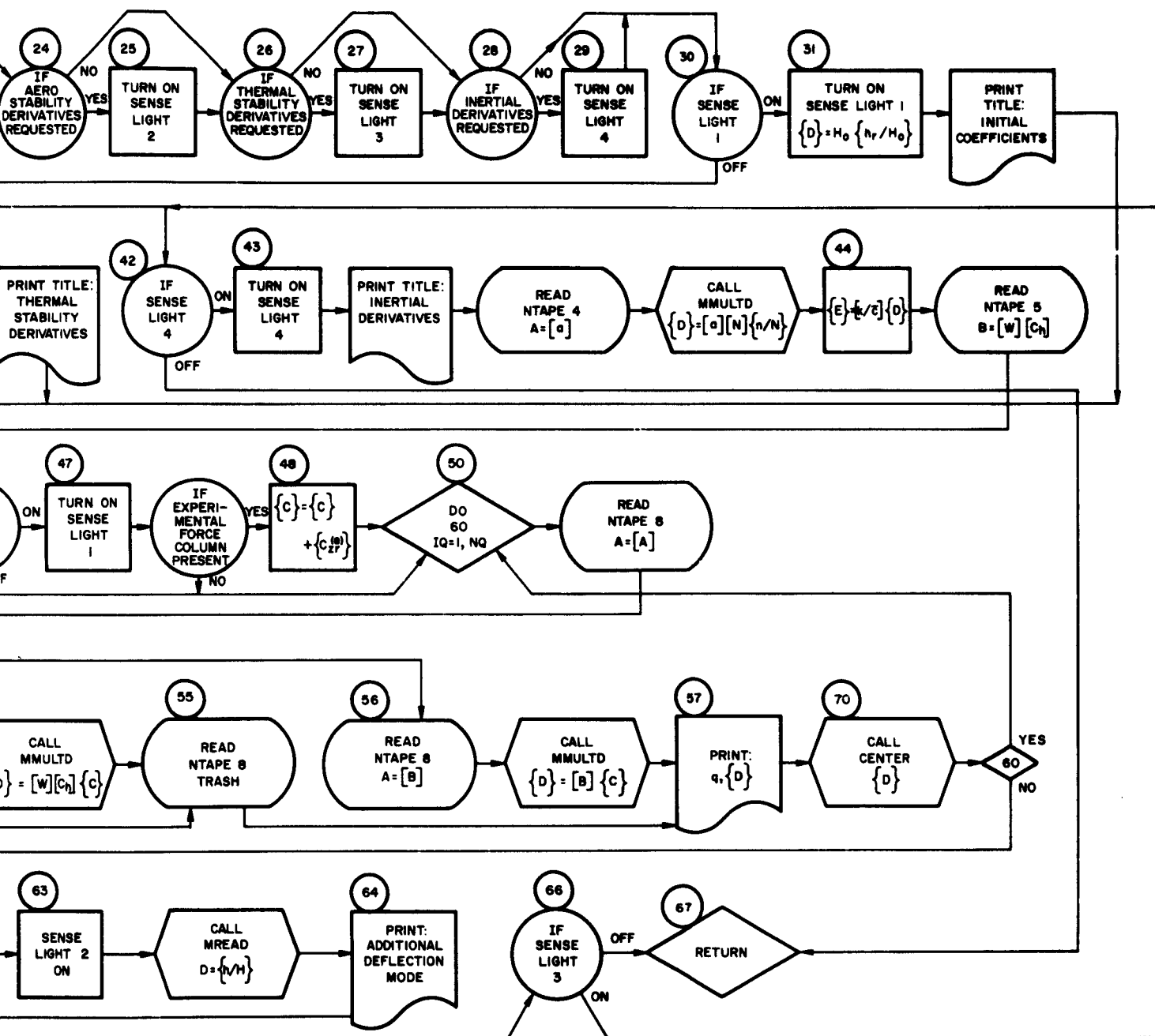


# DIAGRAM - LOADS SUBROUTINE



[illegible]

# GRAM - DERIVATIVES SUBROUTINE



## SECTION VIII

### SYMBOLIC LISTING

Some of the program FORTRAN symbols are defined below.

<u>FORTRAN Symbols</u>	<u>Definitions</u>
A(I,J), B(I,J), C(I,J)	Elements of matrix "working" arrays; also elements of $[a]$ , $[C_h]$ , and $[W]$
ATTIT(I,J)	Element of column matrix representing the product $[a_T]\{t/T\}$
CIOKR	$1/k_r$
CAPH	H
CAPHO	$H_o$
CAPN	N
CAPS	S (reference area)
CAPT	T
CAPXO	$x_o$
CAPZ	Z
CBAR	$\bar{c}$
CNIN(I,J)	Element of column matrix representing the product $[M]\{n/N\}$
CZRE(I,J)	Element of experimental force column matrix
DELY(J)	$\Delta y_j$ (width of strip j)
F(I,J)	Element of total force distribution column
FA(I,J)	Element of final aerodynamic force distribution column
FLEXK	K
FMOM(J,K)	Element in load coefficient matrix $[M/F]$
FR(I,J)	Element of rigid force distribution column
HADD(I,J)	Element of additional deflection mode column
HR(I,J)	Element of initial deflection mode column

<u>FORTRAN Symbols</u>	<u>Definitions</u>
IFORM	IFORM = 1 if matrix is in FORTRAN format; = 0 if matrix is in column binary format
IROW	IROW = 1 if matrix is input by rows; = 0 if matrix is input by columns
L	Number of strips (partitions) in the surface aerodynamic matrix
LH(K)	Row number of last nonzero element in column k of mass matrix
LHIGH(J)	Column number of last nonzero element in row j of [V/F], [M/F], or [T/F]
LL(k)	Row number of first nonzero element in column k of mass matrix
LOW(J)	Column number of first nonzero element in row j of [V/F], [M/F], or [T/F]
NCPT(J)	Number of control points for strip j
NEXST	Number of external stores reserved
NOP(I)	Option i, Field i of control card (data Item 2)
NQ	Number of dynamic pressures read in
NRC	Order of current case
NSTRP	Number of surface strips used for derivatives options
NVMT	Number of rows in [V/F], [M/F], or [T/F]
Q(I)	(i <sup>th</sup> ) dynamic pressure
SHEAR(J, K)	Element in load coefficient matrix [V/F]
SMALS	s
TCCP	Chordwise center of pressure
TORQU(J, K)	Element in load coefficient matrix [T/F]
TSCP	Spanwise center of pressure
X(I)	Element in chordwise coordinate matrix
Y(I)	Element in spanwise coordinate matrix
ZI(I, J)	Location of j <sup>th</sup> control point for strip i

The symbolic listing of the program is shown on the following pages.

DIMENSION	NOP(24), Q(10), X(50), Y(50), ATTIT(50,2), CZRE(50,2),	HH030777
1	HADD(50,2), LL(50), LH(50), CNIN(50,2), HR(50,2),	HH030777
2	NCPT(50), DELY(50), ZI(50,10)	HH030777
DIMENSION	AI50(100), B(50,100), C(50,100)	HH030777
EQUIVALENCE	(NOP(14),NQ), (NOP(13),NEXT), (LH,X), (LL,Y),	HH030777
1	(NOP(17),NRC),(NOP(23),TITL1), (NOP(24),TITL2)	HH030777
COMMON	NOP, X, Y, NTAPE2, NTAPE3, NTAPE4, NTAPE5, NTAPE6, NTAPE8,	HH030778
1	CBAR, FLEX, CAPS, CAPH, CAPT, CAPN, SMALS, CAPXO, CLOKRR(50,78)	HH030779
2	,CAPZ, CAPHO, Q, MAXR, ATTIT, CZRE, CNLM, HR, HADD,	HH030781
3	NSTRP, NCPT, DELY, ZI, MAXQ, NC, MCNRC, A, B, C, I, K1,	HH030782
4	K, L, MGOOF, M, N, NXST, T, CON, IFORM, IROW	HH030783
1	( 1814 )	HH030784
2	FORMAT ( 6E12.8 )	HH030785
3	FORMAT ( 1E10.4X, 13HCONTROL ITEMS / 1H 12X, 5H (1)= 112,	HH030786
1	6H (2)= 112, 6H (3)= 112, 6H (4)= 112, 6H (5)= 112,	HH030787
2	6H (6)= 112, 6H (7)= 112, 6H (8)= 112, 6H (9)= 112,	HH030788
3	/ 1H 12X, 5H(10)= 112, 6H (11)= 112, 6H (12)= 112,	HH030789
4	6H (13)= 112, 6H (14)= 112, 6H (15)= 112, 6H (16)= 112,	HH030790
5	6H (17)= 112, 6H (18)= 112, / 1H 11X, 4HCBAR 15X,	HH030791
6	10HMORM CONST 13X, 4HCAPS 20X, 1HZ 18X, 3HREF H / 1H	HH030792
7	SE21.8 / 1H0 11X, 5HREF T 16X, 5HREF N 17X, 3HSMS 18X,	HH030793
8	2HXD 16X, 6HREF HO / 1H SE21.8 )	HH030794
4	FORMAT ( 1H0 34X, 114, 18H DYNAMIC PRESSURES ( 1H 6E16.8 ) )	HH030795
5	FORMAT ( 1H0 46X, 19H FLEXIBILITY MATRIX )	HH030796
6	FORMAT ( 1H 36X, 1A6, // (1H 24X, 116, 3X, 1E18.8 ) )	HH030797
7	FORMAT ( 1H 36X, 1A6, // (1H 15X, 116, 3X, 2E18.8, 1H1 ) )	HH030798
8	FORMAT ( 1H0 41X, 36H AERODYNAMIC INFLUENCE COEFFICIENTS 5X,	HH030799
1	1A6,3X, 6H1/KR = 1E18.8 // )	HH030800
9	FORMAT ( 1H0 46X, 17H WEIGHTING MATRIX )	HH030801
10	FORMAT ( 1H0 48X, 32H THERMAL INFLUENCE COEFFICIENTS )	HH030802
11	FORMAT ( 1H0 39X, 18H TEMPERATURE MODE / )	HH030803
12	FORMAT ( 1H0 32X, 32H EXPERIMENTAL FORCE COEFFICIENTS / )	HH030804
13	FORMAT ( 1H0 25X, 39H ADDITIONAL DEFLECTION MODE (H/REF H) / )	HH030805
14	FORMAT ( 1H0 29X, 36H INITIAL DEFLECTION MODE (HR/REF HO) / )	HH030806
15	FORMAT ( 1H0 48X, 12H MASS MATRIX )	HH030807
16	FORMAT ( 1H0 39X, 18H LOAD FACTOR MODE / )	HH030808

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17 FORMAT ( 1H0 36X, 22H CHORDWISE COORDINATES / )
18 FORMAT ( 1H0 36X, 21H SPANWISE COORDINATES / )
19 FORMAT ( 1H0 25X, 33H INPUT DATA FOR LOAD DISTRIBUTION
1 13H CALCULATIONS / 1H0 34X, 113, 7H STRIPS / 1H0 36X,
2 22HSTRIP CONTROL POINTS / (1H 26X, 2113 ) )
20 FORMAT ( 1H0 4X, 19HSTRIP DELTA Y(I) 6X, 17HCHORDWISE CONTROL
1 32H POINT LOCATIONS (PERCENT CHORD) )
21 FORMAT ( 1H 117, 1E19.8, 2X, 5E16.8 / (1H 27X, 5E16.8) )
22 FORMAT ( 1H0 10X, 38HERROR RETURN FROM INVERSE SUBROUTINE. )
23 FORMAT (49H0*****CORRECTED EXPERIMENTAL FORCE COEFFICIENTS
1 21H (DYNAMIC PRESSURE = 1E16.8, 1H) / (1H 6E16.8) )
24 FORMAT ( 1H1 )
C NTAPE2 = INPUT TAPE
C NTAPE3 = OUTPUT PRINT TAPE
C NTAPE4 = /
C NTAPE5 = / ARE UTILITY TAPES.
C NTAPE6 = /
C NTAPE8 = /
NTAPE2 = 2
NTAPE3 = 3
NTAPE4 = 5
NTAPE5 = 6
NTAPE6 = 7
NTAPE8 = 8
90 REWIND NTAPE4
REWIND NTAPE5
REWIND NTAPE6
REWIND NTAPE8
B TITL1=606051252143
B TITL2=234644474367
MAXR=50
MAXQ=20
C READ IN TITLE CARD, OPTIONS CARD AND CONSTANTS CARDS AND PRINT.
CALL RDLN (NTAPE2,NTAPE3,1)
READ INPUT TAPE NTAPE2, 1, (NOP(1), I=1,18)

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      READ INPUT TAPE NTAPE2, 2, CBAR, FLEXX, CAPS, CAPZ, CAPH, CAPT,
1     WRITE OUTPUT TAPE NTAPE3, 3, (NOP(I),I=1,18), CBAR, FLEXX, CAPS,
2     CAPZ, CAPH, CAPT, CAPN, SMALS, CAPXO, CAPHO
      CAPHO
C FIRST DETERMINE IF REAL OR COMPLEX.
      NC=1
      IF (NOP(7)) 98,99,98
98     NC=2
99     NCNRC=NC*NRC

C IF ENTERING DYNAMIC PRESSURES, READ AND PRINT.
      IF (NQ) 101,101,100
100    READ INPUT TAPE NTAPE2, 2, (Q(I),I=1,NQ)
      WRITE OUTPUT TAPE NTAPE3, 4, NQ, (Q(I),I=1,NQ)

C READ FLEXIBILITY MATRIX, IF PRESENT, PRINT AND STORE ON TAPE 4.
101    IF (NDP(18)) 102,102,105
102    DO 104 I=1,NRC
      DO 103 J=1,NRC
        A(J,I)=0.
103    A(J,I+1)=0.
104    A(I,I)=0.
      WRITE TAPE NTAPE4, ((A(I,J),J=1, NRC),I=1,NRC)
      GOTO 106
105    READ INPUT TAPE NTAPE2, 1, M, N, IFORM, IROW
      CALL MREAD (A, M, N, IFORM, IROW, 0, 1, B, MAXR, NTAPE2, NTAPE3)
      WRITE TAPE NTAPE4, ((A(I,J),J=1,N),I=1,M)
106    WRITE OUTPUT TAPE NTAPE3, 5
      CALL MPRINT (A, NRC, NRC, MAXR, NTAPE3)

C READ AERODYNAMIC EXTERNAL STORES, IF PRESENT, THEN AERO MATRIX.
C
      DO 107 I=1,NRC
        DO 107 J=1,NCNRC
107      A(I,J)=0.
      IF (NEXST) 111,111,108

```

HH030847  
 HH030848  
 HH030849  
 HH030850  
 HH030851  
 HH030852  
 HH030853  
 HH030854  
 HH030855  
 HH030856  
 HH030857  
 HH030858  
 HH030859  
 HH030860  
 HH030861  
 HH030862  
 HH030863  
 HH030864  
 HH030865  
 HH030866  
 HH030867  
 HH030868  
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```

108 CONTINUE
      READ INPUT TAPE NTAPE2, 1, NXST, N, IFORM, IROW
      IF (NXST) 111,111,110
110 N=NXST*NC
      CALL MREAD (A,NXST,N, IFORM,IROW, 0,0, 8, MAXR, NTAPE2,NTAPE3)

111 READ INPUT TAPE NTAPE2, 2, CIOKR
      READ INPUT TAPE NTAPE2, 1, M, L, IFORM, IROW
      K=NXST+1
      IF (IFORM) 113,112,113
112 K1=NC*K-NC+1
      N=NC*M
      CALL MREAD (A(K,K1), M, N, 0, 0, 1, 8, MAXR, NTAPE2, NTAPE3)
      GOTO 115

113 DO 114 I=1,L
      READ INPUT TAPE NTAPE2, 1, M
      N=NC*M
      K1=NC*K-NC+1
      CALL MREAD (A(K,K1),M,N, 1,IROW,0,0,8, MAXR, NTAPE2, NTAPE3)
114 K=K+M

115 GOTO (116,117),NC
116 T=ITL1
      GOTO 118
117 T=ITL2
118 WRITE OUTPUT TAPE NTAPE3, 8, T, CIOKR
      CALL MPRINT(A, NRC, NCNRC, MAXR, NTAPE3)
      WRITE TAPE NTAPE4, ((A(I,J),J=1,NCNRC),I=1,NRC)

C IF WEIGHTING MATRIX, READ, PRINT AND STORE (W) (CH) ON TAPE 5.
C      OTHERWISE, STORE (CH) ON TAPE 5.
120 IF (NOP(10)) 122,121,122
121 WRITE TAPE NTAPE5, ((A(I,J),J=1,NCNRC),I=1,NRC)
      GOTO 132

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122 IF (NEXST) 127,127,123
123 DO 125 I=1,NEXST
    DO 124 J=1,NEXST
124     B(I,J)=0.
125     B(I,I)=1.

    READ INPUT TAPE NTAPE2, 1, NXST, K, IFORM, IROW
    IF (NXST) 127,127,126
126 CALL MREAD (B,NXST,NXST, IFORM,IROW, 0,0,C, MAXR,NTAPE2,NTAPE3)

127 K=NEXST+1
    READ INPUT TAPE NTAPE2, 1, M, L, IFORM, IROW
    IF (IFORM) 129,128,129
128 CALL MREAD (B(K,K), M, M, 0, 0, 0, 1, C, MAXR, NTAPE2, NTAPE3)
    GOTO 131

129 DO 130 I=1,L
    READ INPUT TAPE NTAPE2, 1, M
    CALL MREAD (B(K,K), M,M,1,IROW,0,0,C,MAXR,NTAPE2,NTAPE3)
130 K=K+M
131 WRITE OUTPUT TAPE NTAPE3, 9
    CALL MPRINT(B,NRC,NRC,MAXR,NTAPE3)

    CALL MMULTD(B,0,A,NOP(7),C,NRC,NRC,MAXR,MAXR,MAXR)
    WRITE TAPE NTAPES, ((C(I,J),J=1,NCNRC),I=1,NRC)

C IF DIVERGENCE OPTION ONLY, GO AND DO.
132 IF (NQ) 133,119,133
119 CALL DIVERG
    GOTO 90

C IF THERMAL DATA PRESENT, READ,PRINT AAD MULTIPLY MATRIX BY MODE AND
C
133 IF (NOP(11)) 136,134,136
134 DO 135 I=1,NC
    DO 135 J=1,NRC
135     ATIT(J,I)=0.
    GOTO 139

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HMO30923  
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136 READ INPUT TAPE NTAPE2, 1, M, N, IFORM, IROM
    CALL MREAD (A, M, N, IFORM, IROM, 0, 1, B, MAXR, NTAPE2, NTAPE3)
    CALL MREAD (B, N, NC, 1, 0, 0, 1, C, MAXR, NTAPE2, NTAPE3)
    CALL MMULTDFA, 0, B, NOP(7), ATTL, NRC, NRC, 1, MAXR, MAXR, MAXR)
    WRITE OUTPUT TAPE NTAPE3, 10
    CALL MPRINT(A, NRC, NRC, MAXR, NTAPE3)
    WRITE OUTPUT TAPE NTAPE3, 11
    IF (NOP(7)) 138, 137, 138
137 WRITE OUTPUT TAPE NTAPE3, 6, TITL1, (1, B(I, 1), I=1, NRC)
    GOTO 139
138 WRITE OUTPUT TAPE NTAPE3, 7, TITL2, (1, (B(I, J), J=1, NC), I=1, NRC)
C IF EXPERIMENTAL FORCE COLUMN PRESENT, READ, PRINT, STORE AT CZRE.
139 IF (NOP(12)) 140, 143, 140
140 CALL MREAD (CZRE, NRC, NC, 1, 0, 0, 0, B, MAXR, NTAPE2, NTAPE3)
    WRITE OUTPUT TAPE NTAPE3, 12
    IF (NOP(7)) 142, 141, 142
141 WRITE OUTPUT TAPE NTAPE3, 6, TITL1, (1, CZRE(I, 1), I=1, NRC)
    GOTO 143
142 WRITE OUTPUT TAPE NTAPE3, 7, TITL2, (1, (CZRE(I, J), J=1, NC), I=1,
    NRC)
2
CREAD INITIAL DEFLECTION MODE FOR OPTIONS REQUIRING IT, IF ANY.
143 IF (NOP(11)+NOP(12)+NOP(13)+NOP(5)) 147, 147, 144
144 WRITE OUTPUT TAPE NTAPE3, 14
    CALL MREAD (HR, NRC, NC, 1, 0, 0, 0, B, MAXR, NTAPE2, NTAPE3)
    IF (NOP(7)) 146, 145, 146
145 WRITE OUTPUT TAPE NTAPE3, 6, TITL1, (1, HR(I, 1), I=1, NRC)
    GOTO 147
146 WRITE OUTPUT TAPE NTAPE3, 7, TITL2, (1, (HR(I, J), J=1, NC), I=1, NRC)
C READ ADDITIONAL DEFLECTION MODE FOR OPTIONS REQUIRING IT, IF ANY.
147 IF (NOP(11)+NOP(12)+NOP(13)+NOP(6)) 151, 151, 148
148 WRITE OUTPUT TAPE NTAPE3, 13
    CALL MREAD (HADD, NRC, NC, 1, 0, 0, 0, B, MAXR, NTAPE2, NTAPE3)
    IF (NOP(7)) 150, 149, 150
149 WRITE OUTPUT TAPE NTAPE3, 6, TITL1, (1, (ADD(I, 1), I=1, NRC)
    GOTO 151

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150 WRITE OUTPUT TAPE NTAPE3, 7, TITL2, (I, (HADD(I,J), J=1, NC), I=1,
    1
    NRC)
C READ MASS MATRIX, IF NEEDED.
151 IF (NOP(1)+NOP(2)+NOP(3)+NOP(9)) 157, 157, 152
152 READ INPUT TAPE NTAPE2, 1, M
    READ INPUT TAPE NTAPE2, 1, ((LL(K), LH(K)), K=1, M)
    DO 153 I=1, NRC
        DO 153 J=1, NRC
            A(I,J)=0.
153 DO 154 I=1, M
        K=LL(I)
        L=LH(I)
154 READ INPUT TAPE NTAPE2, 2, (A(J,I), J=K, L)
    WRITE OUTPUT TAPE NTAPE3, 15
    CALL MPRINT (A, NRC, NRC, MAXR, MAXR, NTAPE3)
C READ LOAD FACTOR MODE (N/N) AND COMPUTE (M)*(N/N) STORED AT CNIN
    CALL MREAD (B, NRC, NC, 1, 0, 0, C, MAXR, NTAPE2, NTAPE3)
    CALL MMULTD(A, 0.8, NOP(7), CNIN, NRC, NRC, 1, MAXR, MAXR, MAXR)
    WRITE OUTPUT TAPE NTAPE3, 16
    IF (NOP(7)) 156, 155, 156
155 WRITE OUTPUT TAPE NTAPE3, 6, TITL1, (I, 8(I,1), I=1, NRC)
    GOTO 157
156 WRITE OUTPUT TAPE NTAPE3, 7, TITL2, (I, (8(I,J), J=1, NC), I=1, NRC)
C READ IN (X) COORDINATES
157 IF (NOP(2)+NOP(3)+NOP(5)+NOP(6)+NOP(8)+NOP(9)+NOP(15)) 159, 159, 158
158 READ INPUT TAPE NTAPE2, 2, (X(I), I=1, NRC)
    WRITE OUTPUT TAPE NTAPE3, 17
    WRITE OUTPUT TAPE NTAPE3, 6, TITL1, (I, X(I), I=1, NRC)
C READ IN (Y) COORDINATES
159 IF (NOP(5)+NOP(6)+NOP(8)+NOP(9)+NOP(15)) 166, 166, 160
160 READ INPUT TAPE NTAPE2, 2, (Y(I), I=1, NRC)
    WRITE OUTPUT TAPE NTAPE3, 18
    WRITE OUTPUT TAPE NTAPE3, 6, TITL1, (I, Y(I), I=1, NRC)

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C READ IN NUMBER OF STRIPS, AND CONTROL POINTS PER STRIP.
  READ INPUT TAPE NTAPE2, 1, NSTRP, (NCPT(I), I=1, NSTRP)
  WRITE OUTPUT TAPE NTAPE3, 19, NSTRP, (I, NCPT(I), I=1, NSTRP)
  DO 164 I=1, NSTRP
    M=NCPT(I)
    READ INPUT TAPE NTAPE2, 2, (DELY(I), (ZI(I, J), J=1, M))
    164 WRITE OUTPUT TAPE NTAPE3, 21, (I, DELY(I), (ZI(I, J), J=1, M))

C COMPUTE.....
C (A) = ( (I)-KQS/CBAR * (FLEXIBILITY)*(WEIGHTING)*(AERODYNAMIC) )
C      INVERSE
C (B) = (I)+KQS/CBAR * (WEIGHTING)*(AERODYNAMIC)*(A)*(FLEXIBILITY)
C
C STORE (A) AS RECORD NUMBER 1 AND (B) AS RECORD NUMBER 2 ON NTAPES
C      BY ROWS, REAL OR COMPLEX.
C
166 REWIND NTAPE4
REWIND NTAPES
REWIND NTAPE6
REWIND NTAPES

C READ AERO DATA, (W)(CH) FROM NTAPES, AND FLEX., (A) FROM NTAPE4
  READ TAPE NTAPES, ((C(I, J), J=1, NCNRC), I=1, NRC)
  READ TAPE NTAPE4, ((B(I, J), J=1, NRC), I=1, NRC)
  REWIND NTAPES
  REWIND NTAPE4
  CALL MMULTD (B, O, C, NOP(7), A, NRC, NRC, NRC, MAXR, MAXR, MAXR)
  WRITE TAPE NTAPE6, ((A(I, J), J=1, NCNRC), I=1, NRC)
  REWIND NTAPE6

  DO 204 IQ=1, NQ
    C EXPECT ( (A)*(W)*(CH) ) IN A ARRAY.
    CON=FLEXK*Q(IQ)*CAPS/CBAR
    DO 168 I=1, NCNRC
      DO 168 J=1, NRC

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HH031038  
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168  A(J,I)=-CON*A(J,I)
      K=0
      DO 169 I=1,NCNRC,NC
        K=K+1
169  A(K,I)=1.+A(K,I)
170  DO 171 I=1,NCNRC,NC
      K=I/2+1
      DO 171 J=1,NRC
        A(J,K)=A(J,I)
171  B(J,K)=A(J,I+1)

172  CALL MNVRSX (A,B,A(1,MAXR+1),C,NRC,MGOOF,NOP(7))
      IF (MGOOF) 174,176,174

174  WRITE OUTPUT TAPE NTAPE3, 22
      Q(IQ)=-1.
      GOTO 202

176  IF (NOP(7)) 177,182,177
177  DO 178 I=1,NCNRC,NC
      K=I/2+1
      DO 178 J=1,NRC
        C(J,I)=A(J,K)
178  C(J,I+1)=B(J,K)
      DO 180 I=1,NCNRC
        DO 180 J=1,NRC
180  A(J,I)=C(J,I)

182  WRITE TAPE NTAPE8, ((A(I,J),J=1,NCNRC), I=1,NRC)

C READ FLEXIBILITY MATRIX INTO B ARRAY.
  READ TAPE NTAPE4, ((B(I,J),J=1,NRC), I=1,NRC)
  REWIND NTAPE4

      CALL MMULTD (A,NOP(7),B,C,NRC,NRC,MAXR,MAXR,MAXR,MAXR)

C READ AERO MATRIX INTO B ARRAY.

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 HMO31101  
 HMO31102  
 HMO31103  
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 HMO31107  
 HMO31108  
 HMO31109  
 HMO31110  
 HMO31111  
 HMO31112  
 HMO31113

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READ TAPE NTAPES, ((B(I,J),J=1,NCNRC),I=1,NRC)
REWIND NTAPES
CALL MMULTD (B, NOP(7),C,NOP(7),A,NRC,NRC,NRC,MAXR,MAXR,MAXR)

DO 184 I=1,NCNRC
  DO 184 J=1,NRC
    184 A(J,I)=CON=A(J,I)

185 K=0
DO 186 I=1,NCNRC,NC
  K=K+1
  186 A(K,I)=1.+A(K,I)

188 WRITE TAPE NTAPES, ((A(I,J),J=1,NCNRC),I=1,NRC)

IF (NOP(15)) 202,202,189
189 WRITE OUTPUT TAPE NTAPES, 24
IF (NOP(7)) 190,192,190
190 DO 191 I=1,NCNRC,NC
  K=I/2+1
  DO 191 J=1,NRC
    A(J,K)=A(J,I)
  191 B(J,K)=A(J,I+1)
192 CALL MNVRSX (A,B,A(1,MAXR+1),C,NRC,MGOOF,NOP(7))
IF (MGOOF) 194,196,194
194 WRITE OUTPUT TAPE NTAPES, 22
GOTO 202

196 IF (NOP(7)) 197,200,197
197 DO 198 I=1,NCNRC,NC
  K=I/2+1
  DO 198 J=1,NRC
    C(J,I)=A(J,K)
  198 C(J,I+1)=B(J,K)
DO 199 I=1,NCNRC
  DO 199 J=1,NRC
    199 A(J,I)=C(J,I)
200 CALL MMULTD (A,NOP(7),CZRE,NOP(7),B,NRC,NRC,1,MAXR,MAXR,MAXR)

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HM031168

**END(1,0,C,C,0,0,0,0,0,0,0)**

**STORAGE NOT USED BY PROGRAM**

DEC OCT  
16293 37645

DEC UCT  
2717 05235

# STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

A	31305	75111	ATT1T	32409	77231	B	26305	63301	C10KR	32423	77247	DEC	OCT
CAPHO	32421	77245	CAPH	32426	77254	CAPN	32426	77252	CAPS	32429	77255	DEC	OCT
CAPT	32427	77253	CAPXO	32424	77250	CAPZ	32422	77246	CBAR	32431	77257	DEC	OCT
CNIN	32209	76721	CON	16296	37650	C	21305	51471	CZRE	32309	77065	DEC	OCT
DELY	31858	76162	FLEXK	32430	77256	HADD	32009	76411	HR	32109	76555	DEC	OCT
IFORM	16295	37647	IROW	16294	37646	I	16305	37661	K1	16304	37660	DEC	OCT
K	16303	37657	LH	32337	77431	LL	32487	77347	L	16302	37656	DEC	OCT
MAXQ	31308	77514	MAXR	32410	77232	MGOOF	16301	37365	M	16300	37654	DEC	OCT
NCNRC	31306	75112	NCPT	31908	76244	NC	31307	75113	NEXT	32549	77445	DEC	OCT
NDP	32561	77461	NQ	32548	77444	NRC	32545	77441	N	16299	37765	DEC	OCT
NSTRP	31909	76245	NTAPE2	32433	77265	NTAPE3	32436	77264	NTAPE4	32435	77263	DEC	OCT
NTAPE5	32434	77262	NTAPE6	32433	77261	NTAPE8	32432	77260	NXST	16298	37652	DEC	OCT
Q	32420	77244	SMALS	32425	77251	TITL1	32539	77432	TITL2	32538	77432	DEC	OCT
T	16297	37651	X	32537	77431	Y	32487	77347	Z1	31808	76100	DEC	OCT

## SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

EFN	LOC	EFN	LOC	EFN	LOC	EFN	LOC	EFN	LOC
811	1 05214	812	2 05212	813	3 05210	814	4 05051		
815	5 05037	816	6 05030	817	7 05017	818	8 05005		
819	9 04764	81A	10 04755	81B	11 04744	81C	12 04735		
81D	13 04724	81E	14 04712	81F	15 04700	81G	16 04672		
81H	17 04663	81I	18 04653	81J	19 04643	81K	20 04604		
81L	21 04662	81M	22 04551	81N	23 04537	81O	24 04512		

**LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM**

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DEC	OCT	DEC	OCT	DEC	OCT
1) 2701 05215	2) 2357 04465	3) 2367 04477	4) 32767 77777		
6) 2371 04503	A)103 2309 04405	A)104 2322 04422	A)106 2335 04437		
A)108 2348 04454	C)60 2705 05221	C)62 2706 05222	C)164 2707 05223		
C)100 2708 05224	C)103 2709 05225	C)104 2710 05226	C)106 2711 05227		
C)108 2712 05230	C)200 2713 05231	C)206 2714 05232	C)20F 2715 05233		
C)206 2716 05234	D)116 412 00634	D)118 460 00714	D)13T 1211 02273		
D)119 1348 02504	D)14P 1474 02702	D)14V 1512 02750	D)25H 1660 03174		
D)250 1744 03320	D)264 1854 03476	D)271 2110 04076	D)350 1743 03317		
D)364 1853 03475	D)41V 648 01210	D)421 692 01264	D)426 748 01354		
D)45S 1792 03400	D)471 2254 04316	D)521 691 01263	D)526 747 01353		
D)65S 1791 03377	D)671 2253 04315	E)7 140 00214			

LOCATIONS OF NAMES IN TRANSFER VECTOR

DEC	OCT	DEC	OCT	DEC	OCT
CENTER 16 00020	DERIV 18 00022	DIVERG 12 00014	LOADS 17 00021		
MMULTD 11 00013	MNVRX 15 00017	MPRINT 10 00012	MREAD 9 00011		
RDLN 2 00002	(FIL) 6 00006	(FPT) 0 00000	(RLR) 14 00016		
(RTM) 4 00004	(RWT) 1 00001	(STB) 7 00007	(STH) 5 00005		
(TSB) 13 00015	(TSH) 3 00003	(WLR) 8 00010			

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

CENTER	DERIV	LOADS	MNVRX	MPRINT	MREAD
(FIL)	(FPT)	(RLR)	(RWT)	(STB)	(STH)
(TSH)	(WLR)				

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC
90 36 00056	98 60 00207	61 00215	100 63 00225		
101 74 00255	102 75 00260	78 00301	104 79 00306		
105 88 00343	106 99 00422	107 104 00451	108 106 00464		
110 110 00504	111 113 00526	112 119 00566	113 124 00630		
114 131 00700	115 132 00715	116 133 00717	117 135 00722		
118 136 00724	120 147 00771	121 148 00775	122 156 01023		

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123	157 01027	124	159 01043	125	160 01050	126	164 01103
127	166 01123	128	170 01160	129	173 01204	130	178 01246
131	179 01265	132	191 01355	133	192 01361	133	1 4 01365
134	195 01371	135	197 01407	136	199 01421	137	212 01547
138	219 01572	139	227 01631	140	228 01633	141	232 01665
142	239 01710	143	247 01747	144	248 01756	145	252 02006
146	259 02031	147	267 02070	148	268 02077	149	272 02127
150	279 02152	151	287 02211	152	288 02220	153	299 02256
154	303 02306	155	317 02422	156	324 02445	157	332 02505
158	333 02517	159	345 02560	160	346 02570	164	380 02724
166	387 02751	168	421 03133	169	425 03211	170	427 03223
171	431 03303	172	432 03321	174	435 03336	176	438 03346
177	439 03350	178	443 03432	180	446 03464	182	447 03477
184	476 03654	185	477 03666	186	480 03726	188	481 03736
189	489 03773	190	491 04003	191	495 04062	192	496 04077
194	499 04114	196	501 04121	197	502 04123	198	506 04201
199	509 04233	200	510 04244	202	522 04317	204	529 04350
206	531 04366	207	532 04367	208	533 04376	209	534 04377
210	535 04403	211	536 04404				

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MPRINT

```

C      SUBROUTINE MPRINT (A,M,N,MA,NTAPE )
C
C      A = MATRIX TO BE PRINTED
C      M = NUMBER OF ROWS
C      N = NUMBER OF COLUMNS
C      MA = DIMENSIONED NUMBER OF ROWS
C      NTAPE = TAPE NUMBER FOR PRINTING
C
      SUBROUTINE MPRINT (A,M,N,MD,NTAPE )
      DIMENSION A(1), IT(6), C(6)
      EQUIVALENCE (IT,C)
      2 FORMAT ( 1H0 4X, 6( 6X, 7HCOLUMN 114) / )
      3 FORMAT ( 1H 114, X, (6E 17.8) )
      N1=M
      N2=6
      N3=6
      N4=1
      4 IF (N3-N1) 6,6,5
      5 N2=N1-N3+6
      N3=N1
      6 K=0
      DO 7 I= N4,N3
        K=K+1
        IT(K)=1
      7 WRITE(OUTPUT,TAPE, 2, ( IT(1),I=1,N2)
      DO 9 I=1,M
        K=0
        4-MD=(N4-1)+1
        DO 8 J=N4,N3
          K=K+1
          C(K)=A(I,J)
          1=1+MD
      8 WRITE(OUTPUT,TAPE, 3, I, (C(K),K=1,N2)
      9 IF (N3-N1) 10,11,11
      10 N3=N3+6
      N4=N4+6

```



MPRENT

6/22/62

STORAGE NOT USED BY PROGRAM

DEC OCT  
189 00275 32561 77461

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

DEC OCT  
C 188 00274 IT 188 00274 DEC OCT

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

DEC OCT  
1 182 00266 K 181 00265 DEC OCT  
N2 178 00262 N3 177 00261 N4 176 00260 N1 179 00263

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

EFN LOC  
812 2 00251 813 3 00241 EFN LOC

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

DEC OCT  
1) 171 00253 2) 149 00225 DEC OCT  
C160 173 00255 C162 174 00256 C1202 175 00257 9) 170 00252  
E1E 137 00211

LOCATIONS OF NAMES IN TRANSFER VECTOR

DEC OCT  
(FIL) 1 00001 (STH) 0 00000 DEC OCT

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

(FIL) (STH)

NPRT

6/22/62

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
4	21	00036	5	12	00043	6	14	00051
8	29	00151	9	30	00157	10	37	00212
						11	40	00221

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SUBROUTINE MMULTD (A,N1,B,N2,C,M,N,K,MA,MB,MC)

DIMENSION A(1), B(1), C(1)

IC=1

IA=MC\*K

IB=MA\*N

ID=MA

IH=MC

IJ=MC

IF ( N1 ) 4,3,4

3 IF ( N2 ) 7,8,7

4 IB=2\*IB

ID=2\*ID

IF ( N2 ) 5,6,5

5 IC=2

GOTO 7

6 IH=2\*IH

IC=3

7 IA=2\*IA

IJ=2\*IJ

8 DO 18 I=1,M

INC=0

DO 11 J=1,IA,IH

C(J)=0.

IN=INC

DO 10 L=1,IB,ID

IN=IN+1

C(J)=C(J)+A(L)\*B(IN)

11 INC=INC+MB

INC=0

GOTO (18,12,15),IC

12 DO 14 J=1,IA,IJ

IE=I+MA

IF=J+MC

IN=INC

DO 13 L=IE,IB,ID

HM030043  
HM030044  
HM030045  
HM030046  
HM030047  
HM030048  
HM030049  
HM030050  
HM030051  
HM030052  
HM030053  
HM030054  
HM030055  
HM030056  
HM030057  
HM030058  
HM030059  
HM030060  
HM030061  
HM030062  
HM030063  
HM030064  
HM030065  
HM030066  
HM030067  
HM030068  
HM030069  
HM030070  
HM030071  
HM030072  
HM030073  
HM030074  
HM030075  
HM030076  
HM030077  
HM030078  
HM030079  
HM030080

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HM030081  
HM030082  
HM030083  
HM030084  
HM030085  
HM030086  
HM030087  
HM030088  
HM030089  
HM030090  
HM030091  
HM030092  
HM030093  
HM030094  
HM030095  
HM030096  
HM030097  
HM030098

```

IN=IN+1
IG=IN+MB
C(IF)=C(IF)+A(L)*8(IN)
C(J)=C(J)-A(L)*8(IG)
13 INC=INC+MB *2
14 GOTO 18
15 IE=I+MC
IF=I+MA
DO 17 J=IE,IA,IJ
IN=INC
C(J)=0.
DO 16 L=IF,IB,ID
IN=IN+1
C(J)=C(J)+A(L)*8(IN)
16 INC=INC+MB
17 CONTINUE
18 RETURN
END(1,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0)

```

9/04/62

# STORAGE NOT USED BY PROGRAM

DEC	OCT
309	00465
32561	77461

## STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

DEC	OCT	DEC	OCT	DEC	OCT
IA	308 00464	IB	307 00463	IC	306 00462
IE	304 00460	IF	303 00457	IG	302 00456
IJ	300 00454	IK	299 00453	IL	298 00452
J	296 00450				

## LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

DEC	OCT	DEC	OCT	DEC	OCT
21	278 00426	31	282 00432	61	283 00433
C1G0	290 00442	C1G2	291 00443	C1G3	292 00444
C1G5	294 00446	C1200	295 00447	01200	174 00256
D140M	268 00414	E11	81 00121		

## EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
3	11	00122	4	12	00126	5	15	00140
7	19	00155	8	21	00165	10	28	00223
12	32	00246	13	40	00317	14	41	00327
16	50	00377	17	51	00405	18	52	00415

7/26/62

MREAD

```

C MATRIX READ SUBROUTINE
C CALL MREAD (A,M,N,IFORM,IROW,ITRA,IORG,T,MD,NTAPE2,NTAPE3)
C
C A = MATRIX TO READ IN      ITRA = 0, TRA CARD AFTER MATRIX
C N = NUMBER OF ROWS          =+1, TRA CARD AFTER EACH ROW
C N = NUMBER OF COLUMNS      (OR COLUMN )
C IFORM = -1, FORMAT(12A6)    IORG = ORIGIN OF FIRST C.B. CARD
C IFORM = 0, COLUMN BINARY    T =MDXN TEMPORARY CELLS
C IFORM = +1, FORMAT(6E12.8) MD= DIMENSIONED NUMBER OF ROWS
C IROW = -0, MATRIX BY COLUMNS IN A
C IROW = +1, MATRIX BY ROWS   NTAPE2 = INPUT TAPE
C                               NTAPE3 = OUTPUT TAPE
C
SUBROUTINE MREAD (A,M,N,IFORM,IROW,ITRA,IORG,T,MD,NTAPE2,NTAPE3)
DIMENSION A(1), T(1)
1 FORMAT (6E12.8)
2 FORMAT (12A6)
3 FORMAT ( / / 26H THATS ALL YOUR DATA.
NN=MD*N
DO 5 I=1,NN
  T(I)=0.
5  A(I)=0.
  IF ( IFORM ) 39,15,6
6  IF ( IROW ) 8,7,8
7  K3=1
  K4=N
  K5=MD
  K6=N-1
  K2=1
  GO TO 9
8  K2=NN
  K3=MD
  K4=N
  K5=1
  K6=0

```

HM030101  
 HM030102  
 HM030103  
 HM030104  
 HM030105  
 HM030106  
 HM030107  
 HM030108  
 HM030109  
 HM030110  
 HM030111  
 HM030112  
 HM030113  
 HM030114  
 HM030115  
 HM030116  
 HM030117  
 HM030118  
 HM030119  
 HM030120  
 HM030121  
 HM030122  
 HM030123  
 HM030124  
 HM030125  
 HM030126  
 HM030127  
 HM030128  
 HM030129  
 HM030130  
 HM030131  
 HM030132  
 HM030133  
 HM030134  
 HM030135  
 HM030136  
 HM030137

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```

MREAD
9 DO 11 I=1,K4
  K1=I-K5-K5+1
  IF (K6) 10,11,10
10 K2=K1+K6
11 READ INPUT TAPE NTAPE2, 1, (A(L),L=K1,K2,K3)
  GOTO 36
15 K1=N
  K2=M
  K3=1
  IF ( IORG-1 ) 16,17,17
16 K3=2
17 IF ( IROW ) 18,19,18
18 K2=N
  K1=M
19 IF ( ITRA ) 22,21,22
21 K1=1
22 K=0
  DO 23 I=1,K1
    K4=K+K3
    K5=1
  CALL BINRD ((K4), K5, L, NTAPE2, NTAPE3 )
  GOTO (23,38,23,23),L
23 K=K+K2

  IF ( IROW ) 28,24,28
24 L=0
  IF ( IORG-1 ) 26,26,25
26 L=IORG-1
26 DO 27 I=1,N
  J=I-MD-MD
  DO 27 K=1,M
    J=J+1
  L=L+1
27 A(J)=TIL)
  GOTO 36

28 L=0
  IF ( IORG-1 ) 30,30,29

```

HM030138  
 HM030139  
 HM030140  
 HM030141  
 HM030142  
 HM030143  
 HM030144  
 HM030145  
 HM030146  
 HM030147  
 HM030148  
 HM030149  
 HM030150  
 HM030151  
 HM030152  
 HM030153  
 HM030154  
 HM030155  
 HM030156  
 HM030157  
 HM030158  
 HM030159  
 HM030160  
 HM030161  
 HM030162  
 HM030163  
 HM030164  
 HM030165  
 HM030166  
 HM030167  
 HM030168  
 HM030169  
 HM030170  
 HM030171  
 HM030172  
 HM030173  
 HM030174  
 HM030175

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HM030176  
HM030177  
HM030178  
HM030179  
HM030180  
HM030181  
HM030182  
HM030183  
HM030184  
HM030185  
HM030186  
HM030187  
HM030188  
HM030189  
HM030190

WREAD

7/26/62

STORAGE NOT USED BY PROGRAM

DEC OCT  
403 00623  
32561 77461

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT
I	402 00622	J	401 00621	K1	400 00620	K2	399 00617
K3	398 00616	K4	397 00615	K5	396 00614	K6	395 00613
K	394 00612	L	393 00611	MN	392 00610		

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

EFN	LOC	EFN	LOC	EFN	LOC
811	1 00576	812	2 00574	813	3 00572

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

DEC	OCT	DEC	OCT	DEC	OCT
2)	361 00551	3)	364 00554	6)	365 00555
C1G1	385 00601	C1G2	386 00602	C1G3	387 00603
C1200	389 00605	C1203	390 00606	C1205	391 00607
D1212	299 00453	D1216	335 00517	E1E	168 00250
E1J	189 00275	E1N	224 00340		

LOCATIONS OF NAMES IN TRANSFER VECTOR

DEC	OCT	DEC	OCT	DEC	OCT
81NRD	2 00002	EXIT	5 00005	(FIL)	4 00004
(STH)	3 00003	(TSH)	0 00000	(RTN)	1 00001

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

81NRD	EXIT	(FIL)	(RTN)	(STH)	(TSH)
-------	------	-------	-------	-------	-------



BINRD ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. FIB11 6/22/62

```

* FIB 11 FEBRUARY 10,1961 ROGER ANDERSON
* FIB 11 APRIL 20,1961 REVISED AND CORRECTED BY R. L. GAUTHIER
*-----
* CALLING SEQUENCE
* TSX BINRD,4
* TSX L(ARRAY)
* TSX L(K1), WHERE K1 IS READ CONTROL.
* TSX L(K2), WHERE K2 IS ERROR CONTROL.
* TSX L(INPUT TAPE NUMBER)
* TSX L(OUTPUT TAPE NUMBER)
*
* K1 = ZERO, READ ONE CARD.
* K1 = NONZERO, READ TO TRANSFER CARD.
*
* IF
* K2 = 1, RECORD(S) READ CORRECTLY.
* K2 = 2, END OF FILE ENCOUNTERED. READ END.
* K2 = 3, CHECKSUM ERROR OR TAPE CHECK.
* K2 = 4, (WHEN K1=0) NEXT RECORD IS BCD.
*-----
* ENTRY BINRD
*
* 00011
*
* TRANSFER VECTOR
0000 743146523460 (IOS)
0001 745124623460 (RDS)
0002 745123303460 (RCH)
0003 746323463460 (TCO)
0004 746351233460 (TRC)
0005 746325263460 (TEF)
0006 742262513460 (BSR)
0007 256731636060 EXIT
0010 746651623460 (MRS)

00011 0634 00 4 00156 BINRD
0012 0634 00 2 00157 SXA
0013 0634 00 1 00160 SXA
0014 0500 60 4 00004 CLA*

00011 0634 00 4 00156 BRDXR4,4
0012 0634 00 2 00157 BRDXR2,2
0013 0634 00 1 00160 BRDXR1,1
0014 0500 60 4 00004 CLA*

```

HM030195  
HM030196  
HM030197  
HM030198  
HM030199  
HM030200  
HM030201  
HM030202  
HM030203  
HM030204  
HM030205  
HM030206  
HM030207  
HM030208  
HM030209  
HM030210  
HM030211  
HM030212  
HM030213  
HM030214  
HM030215  
HM030216

SAVE INDEX REGISTERS.

BRDXR4,4  
BRDXR2,2  
BRDXR1,1  
CLA\* 4,4

HM030217  
HM030218  
HM030219  
HM030220

BIMRD ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. FIBII 6/22/62

00015	0422 00 0 00252	STD	BRD850	HM030221
00016	0580 60 4 00005	CLA	5,4	HM030222
00017	0422 00 0 00251	STD	BRD60	HM030223
00020	-0560 00 0 00245	CAL	BRD10	HM030224
00021	0402 60 4 00003	SLW	3,4	HM030225
00022	-0560 00 0 00245	CAL	BRD10	HM030226
00023	0402 00 0 00243	SLW	ONE	HM030227
00024	-0560 00 4 00001	CAL	1,4	HM030228
00026	0400 00 0 00244	ADD	BRD1A	HM030229
00026	0421 00 0 00100	STA	BRDARY	HM030230
				HM030231
				HM030232
				HM030233
				HM030234
				HM030235
				HM030236
				HM030237
				HM030238
				HM030239
				HM030240
00027	-0560 00 0 00252	BRDRD	BRD850	HM030241
00030	0074 00 4 00000	CALL	(IOS)	HM030242
00031	0522 60 0 00001	BRDRDI	(IOS)	HM030243
00032	-0774 00 4 00257	AXC	BRDCMD,4	HM030244
00033	0522 60 0 00002	XEC	(RCH)	HM030245
00034	-0774 00 4 00035	AXC	+1,4	HM030246
00035	0522 60 0 00003	XEC	(TCO)	HM030247
00036	-0774 00 4 00110	AXC	BRDTPC,4	HM030248
00037	0522 60 0 00004	XEC	(TRC)	HM030249
00040	-0560 00 0 00245	CAL	BRD10	HM030250
00041	0402 00 0 00243	SLW	ONE	HM030251
00042	-0774 00 4 00162	BRDTEF	AXC	HM030252
00043	0522 60 0 00005	XEC	(TEF)	HM030253
				HM030254
				HM030255
				HM030256
				HM030257
				HM030258

SET K2=1. IAN ERROR  
WILL RESET K2.

INITIALIZE LOCATION

OF ARRAY.

READ INPUT TAPE IN BINARY MODE.

IF REDUNDANCY OCCURS, (1) THE RECORD IS IN BCD MODE AND ROUTINE  
WILL INDICATE K2 = 4. IF SINGLE READ OR K2 = 2 IF MULTI  
READ. (2) A LEGITIMATE REDUNDANCY HAS OCCURRED ON A  
BINARY RECORD. A SECOND READ IS ATTEMPTED. IF REDUNDANCY  
PERSISTS A MESSAGE IS WRITTEN ON THE OUTPUT TAPE  
AND K2 IS SET TO 3.

ESTABLISH BINARY I-O  
FOR INPUT TAPE.  
READ SELECT INPUT.

RESET AND LOAD CHANNEL

DELAY

TEST REDUNDANCY.

TEST END-OF-FILE.

TEST FOR TRANSFER CARD.

IF TRANSFER CARD IS ENCOUNTERED, TERMINATE READ.

BINRC ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. F1011 6/22/62

00044 -0500 00 0 77740	BRDTCY CAL	BUFFER	IF DECREMENT (WORD COUNT)	HM030259
00045 -0320 00 0 00250	ANA	BRDD37	IS ZERO, THIS IS	HM030260
00046 0160 00 0 00152	TZE	BRDTCY	A TRANSFER CARD.....	HM030261
	****	TEST TO IGNORE CHECKSUM.		HM030262
00047 -0500 00 0 77740	CAL	BUFFER	IF COL 1, ROW 0	HM030263
00050 -0320 00 0 00254	ANA	BRDIGN	IS PUNCHED, IGNORE	HM030264
00051 -0100 00 0 00071	TNZ	BRDMV	THE CHECKSUM.	HM030265
	*			HM030266
00052 -0560 00 0 77740	CAL	BUFFER	*****	HM030267
00053 -0320 00 0 00250	ANA	BRDD37	***** ACCUMULATE AND CHECK THE CHECKSUM. *****	HM030268
00054 -0734 00 4 00080	PDX	0,4	***** IF CHECKSUM ERROR, WRITE MESSAGE, INDICATE	HM030269
00055 0634 00 4 00063	SXA	BINWDS,4	***** ERROR WITH 3 AT K2, AND CONTINUE.	HM030270
00056 1 C0002 4 00057	TXI	**1,4,2	***** (THE CARD WILL BE MOVED INTO THE ARRAY.)	HM030271
00057 -0634 00 4 00061	SXD	**2,4	*****	HM030272
00060 0774 00 4 77740	AXT	BUFFER,4	*****	HM030273
00061 1 80000 4 00062	TXI	**1,4,8	*****	HM030274
00062 0634 00 4 00065	SXA	BINCK,4	***** SET UP NO. OF	HM030275
00063 0774 00 4 00000	AXT	***4	***** WORDS FOR	HM030276
00064 -0500 00 0 77740	CAL	BUFFER	***** COMPUTING CHECKSUM	HM030277
00065 0361 00 4 00000	BINCK	ACL	*****	HM030278
00066 2 C0001 4 00065	TXI	**1,4,1	*****	HM030279
00067 0322 00 0 77741	ERA	BUFFER+1	***** ACCUMULATE ALL WORDS	HM030280
00070 -0100 00 0 00144	TNZ	BRDCSE	***** EXCEPT CHECKSUM WORD.	HM030281
	*		*****	HM030282
00052 -0560 00 0 77740	CAL	BUFFER	***** CHECKSUM ERROR	HM030283
00053 -0320 00 0 00250	ANA	BRDD37	*****	HM030284
00054 -0734 00 4 00080	PDX	0,4	*****	HM030285
00055 0634 00 4 00063	SXA	BINWDS,4	*****	HM030286
00056 1 C0002 4 00057	TXI	**1,4,2	*****	HM030287
00057 -0634 00 4 00061	SXD	**2,4	*****	HM030288
00060 0774 00 4 77740	AXT	BUFFER,4	*****	HM030289
00061 1 80000 4 00062	TXI	**1,4,8	*****	HM030290
00062 0634 00 4 00065	SXA	BINCK,4	*****	HM030291
00063 0774 00 4 00000	AXT	***4	*****	HM030292
00064 -0500 00 0 77740	CAL	BUFFER	*****	HM030293
00065 0361 00 4 00000	BINCK	ACL	*****	HM030294
00066 2 C0001 4 00065	TXI	**1,4,1	*****	HM030295
00067 0322 00 0 77741	ERA	BUFFER+1	*****	HM030296
00070 -0100 00 0 00144	TNZ	BRDCSE	*****	
	*		*****	
00052 -0560 00 0 77740	CAL	BUFFER	***** MOVE THE CARD IMAGE INTO USERS ARRAY. *****	
00053 -0320 00 0 00250	ANA	BRDD37	***** THE ARRAY IS FILLED IN FORTRAN FASHION. (BACKWARDS)	
00054 -0734 00 4 00080	PDX	0,4	***** THE INDEX NUMBER LOCATES THE FIRST WORD IN ARRAY.	
00055 0634 00 4 00063	SXA	BINWDS,4	***** THE WORD COUNT IS USED TO TERMINATE THE MOVE.	
00056 1 C0002 4 00057	TXI	**1,4,2	***** BY DEFN...IF THE INDEX NUMBER = 1, PLACE FIRST WORD AT L(ARRAY)..	
00057 -0634 00 4 00061	SXD	**2,4	*****	
00060 0774 00 4 77740	AXT	BUFFER,4	*****	
00061 1 80000 4 00062	TXI	**1,4,8	*****	
00062 0634 00 4 00065	SXA	BINCK,4	*****	
00063 0774 00 4 00000	AXT	***4	*****	
00064 -0500 00 0 77740	CAL	BUFFER	*****	
00065 0361 00 4 00000	BINCK	ACL	*****	
00066 2 C0001 4 00065	TXI	**1,4,1	*****	
00067 0322 00 0 77741	ERA	BUFFER+1	*****	
00070 -0100 00 0 00144	TNZ	BRDCSE	*****	
	*		*****	

5/22/62

[illegible]

8INRC ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. FIBII 6/22/62

00124 -0500 00 0 00247	CAL	BRD3D	RECORD IS BCD MODE.	HM030335
00125 0534 00 4 00156	LXA	BRDXR4,4		HM030336
00126 0460 00 0 00245	ADD	BRD1D	SET K2=4 IF MULTI.	HM030337
00127 0692 60 4 00003	SLW*	3,4		HM030338
00130 0020 00 0 00157	TRA	BRDXR2	EXIT FROM 8INRD.	HM030339
00131 -0500 00 0 00243	BRD8YC CAL	ONE	IF REDUNDANCY IS	HM030340
00132 0771 00 0 00001	ARS	1	CONSISTENT, REPORT	HM030341
00133 0602 00 0 00243	SLW	ONE	AND EXIT.	HM030342
00134 0520 00 0 00243	ZET	ONE		HM030343
00135 0220 00 0 00031	TRA	BR, RD1		HM030344
00136 0534 00 4 00156	LXA	BRDXR4,4	SET K2=3.	HM030345
00137 -0500 00 0 00247	CAL	BRD3D		HM030346
00140 0602 60 4 00003	SLW*	3,4		HM030347
00141 0774 00 1 00001	AXT	1,1	INDICATE BAD TAPE	HM030348
00142 0074 00 4 00173	TSX	BRDRPT,4	TO REPORTER.	HM030349
00143 0020 00 0 00042	TRA	BRDTEF	TRANSFER CARD TEST.	HM030350
00144 0774 00 1 00000	BRDCE AXT	0,1	INDICATE CHECKSUM BUM	HM030351
00145 0534 00 4 00156	LXA	BRDXR4,4		HM030352
00146 -0500 00 0 00247	CAL	BRD3D		HM030353
00147 0602 60 4 00003	SLW*	3,4		HM030354
00150 0674 00 4 00173	TSX	BRDRPT,4	TO REPORTER.	HM030355
00151 0020 00 0 00071	TRA	BRDMV	MOVE.	HM030356
00152 0534 00 4 00156	BRDTCO LXA	BRDXR4,4		HM030357
00153 -0560 00 0 77740	CAL	BUFFER	SET K1= TRANSFER ADDRESS	HM030358
00154 0767 00 0 00022	ALS	18	OF TRANSFER CARD.....	HM030359
00155 0622 60 4 00002	STD*	2,4		HM030360
00156 0774 00 4 00000	BRDXR4 AXT	**4		HM030361
00157 0774 00 2 00000	BRDXR2 AXT	**2		HM030362
00160 0774 00 1 00000	BRDXR1 AXT	**1		HM030363
00161 0020 00 4 00006	TRA	6,4		HM030364
00162 0502 00 0 00246	BRDEND CLS	BRD2D	THIS WILL RETURN	HM030365
00163 0522 60 0 00006	XEC*	\$(8SR)	CONTROL TO USER	HM030366
00164 0020 00 0 00165	TRA	**1	AT FIRST EOF, BUT	HM030367
00165 0760 00 0 00002	CHS		WILL TAKE SYSTEM	HM030368

# 01MR8 ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. F1011 6/22/62

00166 -0625 00 0 00164	STL	--2	EXIT WHEN EOF IS	HM030373
00167 -0120 00 0 00007	TMI	SEXIT	ENCOUNTERED AGAIN.....	HM030374
00170 0534 00 4 00156	LXA	BRDXR4,4	....	HM030375
00171 0602 60 4 00003	SLW	3,4	....	HM030376
00172 0020 00 0 00157	TRA	BRDXR2	....	HM030377
				HM030378
				HM030379
				HM030380
				HM030381
				HM030382
				HM030383
				HM030384
00173 0634 00 4 00203	BRDRPT SXA	RPTXR4,4		HM030385
00174 -0500 00 0 00251	CAL	BRD6D	ESTABLISH IO FOR	HM030386
00175 0074 00 4 00000	CALL	(IOS)	OUTPUT TAPE.	HM030387
00176 0522 60 0 00010	XEC	\$IWS)		HM030388
00177 -3 00800 1 00205	TXL	RPTCSE,1,0	TEST TYPE OF ERROR.	HM030389
00200 -0774 00 4 00260	AXC	REDCMD,4		HM030390
00201 0522 60 0 00002	XEC	\$IRCH)		HM030391
00202 0074 00 2 00221	TSX	RPTERR,2		HM030392
00203 0774 80 4 00000	RPTXR4 AXT	..,4		HM030393
00204 0020 00 4 00001	TRA	1,4		HM030394
				HM030395
				HM030396
				HM030397
				HM030398
00205 0774 80 2 00002	RPTCSE AXT	2,2	EDIT THE CONTROL	HM030399
00206 0560 00 0 77740	LDQ	BUFFER	WORD OF BAD CARD,	HM030400
00207 0774 00 1 00006	RPTCSE AXT	6,1	PLACE CONTROL WORD	HM030401
00210 0747 00 0 00003	RPTEDT ALS	3	IN MESSAGE.	HM030402
00211 -0763 00 0 00003	LGL	3		HM030403
00212 2 60001 1 00210	TIX	RPTEDT,1,1		HM030404
00213 6402 00 2 00274	SLW	BRDCHK,2,2		HM030405
00214 2 60001 2 00207	TIX	RPTCSE,2,1		HM030406
00215 -0774 00 4 00261	AXC	CSECMD,4		HM030407
00216 0522 60 0 00002	XEC	\$IRCH)		HM030408
00217 0074 00 2 00221	TSX	RPTERR,2	CHECK WRITE ERROR.	HM030409
00220 0020 00 0 00203	TRA	RPTXR4		HM030410

BINRC RCUTINE TO READ COL BIN CARDS FROM INPUT TAPE. FRII 6/22/62

00221	C634	CO	4	00240	RPTERR	SXA	BRDCOM,4	REMEMBER LAST COMMAND.	HM030411
00222	-0774	00	4	00223	AXC	AXC	**1,4	DELAY AND TEST	HM030412
00223	0522	60	0	00003	XEC*	XEC*	\$(TCO)	REUNDANCY ON OUTPUT.	HM030413
00224	-0774	CO	4	00231	AXC	AXC	IPTPCH,4		HM030414
00225	0522	60	0	00004	XEC*	XEC*	\$(TRC)		HM030415
00226	-0500	CO	0	00252	CAL	CAL	BRDBSD		HM030416
00227	0074	CO	4	00000	CALL	CALL	(IOS)		HM030417
00230	0020	00	2	00001	TRA	TRA	1,2	REESTABLISH IO FOR	HM030418
00231	0522	60	0	00006	IPTPCH	XEC*	\$(BSR)	INPUT TAPE....	HM030419
00232	0522	60	0	00010	XEC*	XEC*	\$(WRS)		HM030420
00233	-0774	CO	4	00234	AXC	AXC	**1,4	BACKSPACE OUTPUT	HM030421
00234	0522	60	0	00003	XEC*	XEC*	\$(TCO)	TAPE AND ERASE.	HM030422
00235	-0774	CO	4	00237	AXC	AXC	**2,4		HM030423
00236	0522	60	0	00004	XEC*	XEC*	\$(TRC)	TURN OFF POSSIBLE	HM030424
00237	0522	60	0	00010	XEC*	XEC*	\$(WRS)	REDUNDANCY.	HM030425
00240	0774	CO	4	00000	BRDCOM	AXT	**4	RETRY WRITE.	HM030426
00241	0522	60	0	00002	XEC*	XEC*	\$(RCH)		HM030427
00242	0020	00	0	00221	TRA	TRA	RPTERR		HM030428
00243	0	00001	0	00000	ONE	PZE	0,0,1		HM030429
00244	0	00000	0	00001	BRD1A	PZE	1		HM030430
00245	0	00001	0	00000	BRD1D	PZE	0,0,1		HM030431
00246	0	00002	0	00000	BRD2D	PZE	0,0,2		HM030432
00247	0	00003	0	00000	BRD3D	PZE	0,0,3		HM030433
00250	0	00037	0	00000	BRD37	PZE	0,0,31		HM030434
00251	0	00003	0	00000	BRD6D	PZE	0,0,3		HM030435
00252	0	00002	0	00020	BRD85D	PZE	16,0,2		HM030436
00253	*0000007777				BRD5A7	OCT	77777		HM030437
00254	1	CG000	0	00000	BRDIGN	PON	0,0,0		HM030438
00255	0	00000	0	77740	BUFORC	PZE	BUFFER		HM030439
00256	0	00000	0	00000	BRDCSV	PZE			HM030440
00257	-3	00033	0	77740	BRDCMD	IOST	0,0,27		HM030441
00260	0	00005	0	00262	REDCMD	IOCD	BRDMG1,0,5		HM030442
00261	0	00006	0	00267	CSECD	IOCD	BRDMG2,0,6		HM030443
									HM030444
									HM030445
									HM030446
									HM030447
									HM030448

\* MESSAGES

BINRD ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. FIBII

6/22/62

00262	016321472560	BRDNG1 BCI	5,1TAPE CHECK ON INPUT IGNORED.	HMO30449
00263	233025234260			HMO30450
00264	464560314547			
00265	6A636C312745			
00266	465125243360			
00267	012330252342	BRDNG2 BCI	3,1CHECKSUM ERROR	HMO30451
00270	626444602551			
00271	514651606060			
00272	606060606060	BRDCHK BCI	3,	HMO30452
00273	606060606060			
00274	606060606060			
	77740	BUFFER EQU	-32	HMO30453
		END		HMO30454

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BINRD ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. FIBII  
POST PRUCESORR ASSEMBLY DATA

275 IS THE FIRST LCCATION NOT USED BY THIS PROGRAM

REFERENCES TO DEFINED SYMBOLS

243	CNE	23,	41,	131,	133,	134
7	EXIT	167				
65	BINCK	62				
11	BINRD					
244	BRC1A	25				
245	BRC1D	20,	22,	40,	126	
246	BRC2D	162				
247	BRC3D	124,	137,	146		
251	BRC6D	17,	174			
71	BRCMV	51,	151			
27	BRORD					
6	(BSR)	110,	163,	231		
0	(ICS)	30,	175,	227		
2	(RCH)	33,	113,	201,	216,	241
1	(RCS)	31				
3	(TCO)	35,	223,	234		
5	(TEF)	43				
4	(TRC)	37,	225,	236		
10	(WRS)	176,	232,	237		
63	BINWDS	55				
253	BRC5A7	120				
100	BRCARY	26				
252	BRC85D	15,	27,	226		
131	BRC8TC	123				
272	BRCCHK	213				
257	BRCAMD	32				
240	BRCOM	221				
144	BRCCE	70				
256	BRCESV	111,	117			
250	BRC37	45,	53,	73		
162	BRCEND	42				
254	BRCIGN	50				
262	BRCMG1	260				
267	BRCMG2	261				

**BINRC ROUTINE TO READ COL BIN CARDS FROM INPUT TAPE. FIBII  
POST PROCESSOR ASSEMBLY DATA**

103	BRCWV1	75
31	BRCRD1	106,
173	BRCAPT	135 142,
152	BRCYCD	150 46
44	BRCICT	
42	BRCIEF	143
110	BRCIPC	36
140	BRCXR1	13
157	BRCXR2	12,
156	BRCXR4	130, 12, 104, 170
77740	BUFER	172 107, 145, 152, 170
255	BUFORG	44, 52, 67, 71, 77,
261	CSECMD	153, 206, 255,
231	IATPCH	224
260	RECCMD	200
285	RPTCSE	177
207	RPTTECH	214
210	RPTEDT	212
221	RPTERR	202,
203	RPTXRR	217, 220 242 173,

**NO ERROR IN ABOVE ASSEMBLY.**

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```

SUBROUTINE ROLM (NTAPE2, NTAPE3, I )
1  FORMAT(80H
2  FORMAT(1H1)
3  FORMAT(4 IHO )
    READ INPUT TAPE NTAPE2, 1
    GO TO (4,5),I
4  WRITE OUTPUT TAPE NTAPE3, 2
    GO TO 6
5  WRITE OUTPUT TAPE NTAPE3, 3
6  WRITE OUTPUT TAPE NTAPE3, 1
    RETURN
END(110,010,0,0,0,0,0,0,1,0,0,0,0,0)

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 HM030471

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STORAGE NOT USED BY PROGRAM

DEC OCT  
76 00114

DEC OCT  
32561 77461

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

811 EFN LOC  
1 00112

812 EFN LOC EFN LOC  
2 00073 813 3 00072

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

61 DEC OCT  
52 00064

C1G0 DEC OCT DEC OCT  
75 00113 E11 28 00034

LOCATIONS OF NAMES IN TRANSFER VECTOR

(FIL) DEC OCT  
3 00003

(RTN) DEC OCT (STH) DEC OCT  
1 00001 2 00002 (TSH) 0 00000

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

(FIL) (RTN) (STH) (TSH)

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN IFN LOC  
8 C0035

EFN IFN LOC EFN IFN LOC  
5 10 00044 6 11 00052

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```

SUBROUTINE MNVREX (AR, AI, B, C, KSZ, IGOOFD, NOP)
  DIMENSION AR(50,50), AI(50,50), B(50,50), C(50,50)
  IGOOFD=0
  IF (NOP) 102, 101, 102
  101 CALL INVERS (AR, KSZ, IGOOFD)
  GO TO 20
  102 CONTINUE
  DO 1 K=1, KSZ
    DO 1 L=1, KSZ
      B(K,L)=AR(K,L)
    END DO
  END DO
  NG=0
  CALL INVERS(B, KSZ, NG)
  IF (NG) 2, 3, 2
  2 REAR MATRIX NOT SINGULAR
  3 MULT B=AI STOJ C
  DO 4 K=1, KSZ
    DO 4 L=1, KSZ
      C(K,L)=0.0
    END DO
  END DO
  4 C(K,L)=C(K,L)+B(K,L)*AI(L,L)
  5 MULT, AI=C*AR STOJ B
  DO 5 K=1, KSZ
    DO 5 L=1, KSZ
      B(K,L)=AR(K,L)
    END DO
  END DO
  6 B(K,L)=B(K,L)+AI(K,L)*C(L,L)
  NG=0
  CALL INVERS(B, KSZ, NG)
  IF (NG) 2, 7, 2
  7 SECOND MATRIX NOT SINGULAR
  7 MULT, -C=B STOJ AI ALSO SET AR=B
  DO 8 K=1, KSZ
    DO 8 L=1, KSZ
      AI(K,L)=0.0
    END DO
  END DO
  AR(K,L)=B(K,L)
  DO 8 L=1, KSZ

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STORAGE NOT USED BY PROGRAM

DEC OCT  
513 01001  
32561 77461

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

DEC OCT DEC OCT DEC OCT  
NC 512 01000

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

DEC OCT DEC OCT DEC OCT  
2) 499 00763 3) 502 00766 6) 503 00767 DEC OCT  
C110G 510 00776 C1101 511 00777 D120E 228 00344 9) 508 00774  
D1411 362 00552 D141E 463 00717 D140L 284 00434

LOCATIONS OF NAMES IN TRANSFER VECTOR

DEC OCT DEC OCT DEC OCT  
INVERS 0 00000

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

INVERS

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
101	6	00202	102	9	00207	1	12	00222
4	21	00274	5	26	00352	7	31	00406
2	38	00470	9	40	00503	11	45	00524
13	54	00635	15	59	00671	16	64	00732
20	67	00757						

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SUBROUTINE INVERS (A,N,I GOOF D)
CIPENSICN A(50,50),L(50),M(50)
IF ACCUMULATOR OVERFLOW 500,500
500 IF QUOTIENT OVERFLOW 501,501
501 IF DIVIDE CHECK 502,502
502 IGCDFD=0
C SEARCH FOR LARGEST ELEMENT
DO 80 K=1,N
L(K)=K
P(K)=K
BIGA=A(K,K)
DO 20 I=K,N
DO 20 J=K,N
IF(ABS(BIGA)-ABS(A(I,J)))IC,20,20
10 BIGA=A(I,J)
L(K)=I
P(K)=J
P(K)=J
20 CONTINUE
C INTERCHANGE ROWS
JCL=L(K)
IF(L(K)-K)35,35,25
DO 30 I=1,N
HOLD=A(K,I)
A(K,I)=A(JCL,I)
A(JCL,I)=HOLD
30 INTERCHANGE COLUMNS
ICCL=M(K)
IF(M(K)-K)45,45,37
37 DO 40 J=1,N
HOLD=A(J,K)
A(J,K)=A(J,ICCL)
A(J,ICCL)=HOLD
40 INTERCHANGE COLUMNS BY MINUS PIVOT
C DIVIDE COLUMN BY MINUS PIVOT
45 DO 55 IC=1,N
46 IF(IC-K)50,55,60
50 A(IC,K)=A(IC,K)/(-A(K,K))
55 CONTINUE
C REDUCE MATRIX

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56      DO 65 I=1,N
57      4F(A-I,K)57,65,67
58      4F(A-I,K)60,65,60
59      A(I,J)=A(I,K)+A(K,J)+A(I,J)
60      CONTINUE
61      DIVIDE ROW BY PIVOT
62      DO 75 JR=1,N
63      4F(A-JR,I)70,75,70
64      A(I,JR)=A(I,K)+A(K,JR)/A(K,K)
65      CONTINUE
66      CONTINUE PRODUCT OF PIVOTS
67      REPLACE PIVOT BY RECIPROCAL
68      A(K,K)=1.0/A(K,K)
69      CONTINUE COMPLETE OPERATION
70      CONTINUE
71      IF DIVIDE CHECK510,503
72      IF ACCUMULATOR OVERFLOW 510,504
73      IF QUOTIENT OVERFLOW 510,505
74      FIMM ROW AND COLUMN INTERCHANGE
75      X=N
76      K=K-1
77      4F(A-K)150,150,103
78      I=1(K)
79      4F((I-K)120,120,105
80      DO 110 J=1,N
81      HOLD=A(I,K)
82      A(I,N)=A(I,J)
83      A(J,I)=HOLD
84      J=N(K)
85      4F(A-J-K)100,100,125
86      DO 130 I=1,N
87      HOLD=A(K,I)
88      A(K,I)=A(J,I)
89      A(J,I)=HOLD
90      GO TO 100
91      RETURN
92      4 600F D=1

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HM030624

GO TO 150  
END(1,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0)

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STORAGE NOT USED BY PROGRAM

DEC	OCT	DEC	OCT
601	01131	32561	77461

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

DEC	OCT	DEC	OCT	DEC	OCT
1	800 01130	M	550 01046		

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

DEC	OCT	DEC	OCT	DEC	OCT
B124	500 00764	HOLD	499 00763	ICOL	498 00762
I	496 00760	JROW	495 00757	JR	494 00756
K	492 00754				

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

DEC	OCT	DEC	OCT	DEC	OCT
10	472 00730	21	462 00716	31	465 00721
48	466 00722	91	471 00727	C1100	477 00735
C1101	478 00736	C1102	479 00737	C1106	481 00741
C1107	482 00742	C1108	483 00743	C110A	485 00745
C1200	486 00746	C1202	487 00747	C1205	489 00751
C1206	490 00752	C1207	491 00753	C120E	205 00315
D110J	244 00364	D110P	280 00430	D1119	413 00635
D1218	424 00650	D111D	442 00672	D120N	271 00417
D120U	320 08500	D130J	243 00363	D1319	412 00634
D1310	441 00671	D140G	222 00336	D170J	242 00362
D1719	411 00633	D171D	440 00670	E1T	309 00465
E117	379 00573				

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

6/22/62

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
500	6	00104	501	8	00107	502	9	00111	10	17	00246
20	20	00254	25	23	00277	30	26	00305	35	27	00316
37	29	00325	40	32	00343	45	33	00354	46	34	00365
50	35	00370	55	36	00375	56	39	00425	57	40	00431
60	41	00434	65	42	00443	68	44	00501	70	45	00504
75	46	00507	80	48	00517	503	50	00552	504	52	00555
505	54	00560	100	55	00563	103	57	00574	105	59	00603
110	62	00642	120	63	00651	125	65	00660	130	68	00677
150	70	00707	510	72	00713						

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S W E E P X S U B R O U T I N E

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C COMPUTES TRUE MODE AND SWEEPS IT FROM THE MATRIX. (REAL OR COMPLEX)
C
C HTRUE = TRUE MODAL COLUMNS, AS COMPUTED. U = DYNAMIC MATRIX.
C H = SERIES OF MODIFIED MODAL COLUMNS. FL= COLUMN OF EIGENVALUES.
C US = SERIES OF MODIFIED MODAL ROWS OF U.
C MODE = MODE NOW BEING COMPUTED. N = SIZE
C MD = DIMENSIONED NUMBER OF ROWS OF U,US,H,HTRUE
C NX = 1 IF PROBLEM IS REAL.
C = 2 IF PROBLEM IS COMPLEX.
C
SUBROUTINE SWEEPX (HTRUE, U,H, US,FL, MODE, N, MD, NC, INDEX, EP)
DIMENSION H(1), US(1), U(1), HTRUE(1), FL(1), G(4)
M=MODE-1
K1=M*NC*MD
DO 6 J=1,NC
  K=K1+(J-1)*MD
  DO 6 L=1,N
    K=K+1
    HTRUE(K)=H(K)
  6 IF ( M ) 31,31,8
  8 DO 25 I=1,M
    L1=NC*MD*(MODE-1) -NC*MD
    GOTO ( 9,11),NC
  9 G=0.
  DO 10 J=1,N
    L=L1+J
    K=K1+J
  10 G=G+US(L)*HTRUE(K)
  11 G(1)=0.
    G(2)=0.
  DO 12 J1=1,N
    L=L1+J1
    K=K1+J1
    L2=L+MD
    K2=K+MD

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S W E E P X S U B R O U T I N E

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12 G(1)=G(1)+US(L)*HTRUE(K)-US(L2)*HTRUE(K2)
13 G(2)=G(2)+US(L)*HTRUE(K2)+US(L2)*HTRUE(K)
14 K=MODE-1
15 GOTO (14,19),NC
16 IF (ABS(F(L(K)/FL(MODE)-1.) - EP) 15,15,16
17 G=1.
18 GOTO 17
19 G=(FL(K)-FL(MODE)) / G
20 DO 18 J=1,N
21 K=K1+J
22 L=L1+J
23 HTRUE(K)=H(L)-G(1)*HTRUE(K)
24 GOTO 25
25 J=2*MODE
26 K=2*K
27 IF (ABS(F(FL(K-1)*FL(J-1)+FL(K)*FL(J))/(FL(J-1)*2+FL(J)*2)-1.)
28 1 IF (ABS(F(FL(K)*FL(J-1)-FL(K-1)*FL(J)) / (FL(J-1)*2+FL(J)*2))
29 1 -EP) 21,21,22
30 G(1)=1.
31 G(2)=0.
32 GOTO 23
33 G(3)=G(1)*2+G(2)*2
34 G(4)=(FL(K)-FL(J))*G(1)-(FL(K-1)-FL(J-1))*G(2)
35 G(1)=(FL(K-1)-FL(J-1))*G(1)+(FL(K)-FL(J))*G(2) / G(3)
36 G(2)=G(4) / G(3)
37 DO 24 J1=1,N
38 K=K1+J1
39 K2=K+ MD
40 L=L1+J1
41 L2=L+MD
42 G(3)=HTRUE(K)
43 HTRUE(K)=H(L)+ G(2)*HTRUE(K2)-G(1)*HTRUE(K)
44 HTRUE(K2)=H(L2)-G(1)*HTRUE(K2)-G(2)*G(3)
45 CC CONTINUE
46 I=0
47 CALL NPNRMX (HTRUE(K1+1),HTRUE(K1+1),N,C,I,MD,NC,1)

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HM030702



**2/20/63**

DEC	OCT
744 01350	32561 77461

### STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

DEC OCT  
G 743 01347

### STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

1	DEC	OCT
K2	739	01343
12	735	01337
	731	01333

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

[illegible]

# LOCATIONS OF NAMES IN TRANSFER VECTOR

NPNNRMX  
DEC OCT  
0 00000

DEC OCT

2/20/63

**NPNRMX**

[illegible]

CENTER OF PRESSURE SUBROUTINE

12/04/62

```

SUBROUTINE CENTER ( A )
  DIMENSION NOP(24), Q(10), X(50), Y(50), ATT(50,2), CZRE(50,2),
1    HADD(50,2), LL(50), LH(50), CNIN(50,2), HR(50,2),
2    NCPT(50), DELY(50), ZI(50,10)
  DIMENSION A(50,2), CL(2), CM(2), CZ(2), TCCP(2), TSCP(2)
  EQUIVALENCE (NOP(14),NQ), (NOP(13),NEXST), (LH,X), (LL,Y),
1    (NOP(17),NRC), (NOP(23),TITL), (NOP(24),TITL2)
  COMMON NOP,X,Y,NTAPE2,NTAPE3,NTAPE4,NTAPE5,NTAPE6,NTAPE8,CBAR,
1    FLEXK,CAPS,CAPH,CAPT,CAPN,SMALS,CAPXO,CLOKR,CAPZ,CAPHO,Q,
2    MAXR,ATTIT,CZRE,CNIN,HR,HADD,NSTRP,NCPT,DELY,ZI,MAXQ,NC,
3    NCNRC
200 FORMAT (1H0 35X, 24HAERODYNAMIC COEFFICIENTS / 1H0 11X, 5HCZ =
1    1E16.8, 11X, 5HCM = 1E16.8, 11X, 5HCL = 1E16.8 / 1H0
2    5X, 47HTOTAL CHORDWISE CENTER OF PRESSURE (XBAR-X0)/
3    7HCBAR = 1E16.8 / 1H0 5X, 26H TOTAL SPANNWISE CENTER
4    28H PRESSURE YBAR/S = 1E16.8 / 1H0 19X,
5    6H STRIP 13X, 8HCCLC/CAVE 13X, 15HLOCAL CHORDWISE
6    3H CP )
201 FORMAT (1H 16X, 117, 2E26.8 )
202 FORMAT (1H0 30X, 24HAERODYNAMIC COEFFICIENTS / 4HOCZ=
1    2E15.8, 6H1 CM= 2E15.8, 6H1 CL= 2E15.8,
2    1H1 / 1H0 5X, 36HTOTAL CHORDWISE CENTER OF PRESSURE
3    18H (XBAR-X0)/CBAR = 2E16.8, 1H1 / 1H0 5X, 6H TOTAL
4    48H SPANNWISE CENTER OF PRESSURE YBAR/S =
5    2E16.8, 1H1 / 1H0 9H STRIP 16X, 8HCCLC/CAVE 35X,
6    18HLOCAL CHORDWISE CP )
204 FORMAT (1H 117, 2E20.8, 1H1 5X, 2E20.8, 1H1)

DO 206 N=1,NC
  CZ(N)=0.
  CL(N)=0.
  CM(N)=0.
DO 205 I=1,NRC

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 HM031190  
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 HM031192  
 HM031193  
 HM031194  
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 HM031196  
 HM031197  
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 HM031199  
 HM031200  
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 HM031206  
 HM031207

CENTER OF PRESSURE SUBROUTINE

12/04/62

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      CZ(N)=CZ(N)+A(I,N)
      CL(N)=CL(N)+Y(I)*A(I,N)
205      CM(N)=CM(N)+(X(I)-CAPXO)*A(I,N)
      CL(N)=CL(N)/SMALS
206      CM(N)=CM(N)/CBAR
      IF (NC-1)      207,207,208
207      TCCP(1)=-CM(1)/CZ(1)
      TSCP(1)= CL(1)/CZ(1)
      WRITE OUTPUT TAPE NTAPE3, 200, CZ(1),CM(1),CL(1), TCCP(1), TSCP(1),
      GOTO 210
208      CD=CZ(1)*2+CZ(2)*2
      TCCP(1)=-((CM(1)*CZ(1)+CM(2)*CZ(2)) / CD
      TCCP(2)=-((CM(2)*CZ(1)-CM(1)*CZ(2)) / CD
      TSCP(1)= (CL(1)*CZ(1)+CL(2)*CZ(2)) / CD
      TSCP(2)= (CL(2)*CZ(1)-CL(1)*CZ(2)) / CD
      WRITE OUTPUT TAPE NTAPE3, 202, CZ(1),CZ(2),CM(1),CM(2),CL(1),
1      CL(2),TCCP(1),TCCP(2),TSCP(1),
2      TSCP(2)
210      L=0
      IF (NEXST)      212,212,211
211      L=NEXST
212      DO 217 I=1,NSTRP
          L=L+1
          L=L+NCPT(I)-1
          DO 214 N=1,NC
              CM(N)=0.
              CZ(N)=0.
              L2=0
              DO 213 J=L1,L
                  L2=L2+1
              CM(N)=CM(N)+Z(I,L2)*A(J,N)
              CZ(N)=CZ(N)+A(J,N)
213      CL(N)=-CZ(N)*SMALS / DELY(I)
214

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CENTER OF PRESSURE SUBROUTINE

```

      IF (NC-1)      216,216,215
215  CD=CZ(1)*2+CZ(2)*2
      CE=CM(2)*CZ(1)-CM(1)*CZ(2)
      CM(1)=(CM(1)*CZ(1)+CM(2)*CZ(2)) / CD
      CM(2)= CE/CD
      WRITE OUTPUT TAPE NTAPE3, 204, I, CL(1), CL(2), CM(1), CM(2)
      GOTO 217

216  CM(1)=CM(1) / CZ(1)
      WRITE OUTPUT TAPE NTAPE3, 201, I, CL(1), CM(1)
217  CONTINUE

      RETURN

      END(1,0,0,0,0,0,0,0,0,1,0,0,0,0,0)

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HM031246  
HM031247  
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HM031258  
HM031259

# CENTER OF PRESSURE SUBROUTINE

12/04/62

## STORAGE NOT USED BY PROGRAM

DEC OCT  
518 01006  
31305 75111

## STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

ATT1Y 32409 77231	DEC OCT	DEC OCT	DEC OCT
CAPN 32426 77252			CAPH 32428 77254
CAPZ 32422 77246			CAPXO 32424 77250
DELY 31858 76162			CZRE 32309 77065
LH 32537 77431			HR 32109 76555
NCNRC 31306 75112			MAXR 32410 77232
NOP 32561 77461			NEXST 32549 77445
NTAPE2 32437 77265			NSTRP 31909 76245
NTAPE6 32433 77261			NTAPE5 32434 77262
TITL1 32539 77433			SMALS 32425 77251
ZI 31808 76100			Y 32487 77347

## STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

CL 517 01005	DEC OCT	DEC OCT	DEC OCT
TSCP 509 00775			TCCP 511 00777

## STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

CD 507 00773	DEC OCT	DEC OCT	DEC OCT
L2 503 00767			L1 504 00770

## SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

8168	200 00753	EFN LOC	816A	202 00641	EFN LOC	816C	204 00532
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CENTER OF PRESSURE SUBROUTINE

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LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

DEC	OCT	DEC	OCT	DEC	OCT
1) 493 00755	2) 329 00511	3) 333 00515	6) 334 00516		
9) 492 00754	A)101 316 00474	C)160 497 00761	C)161 498 00762		
C)100 499 00763	C)101 500 00764	C)102 501 00765	D)408 207 00317		
D)508 206 00316					

LOCATIONS OF NAMES IN TRANSFER VECTOR

DEC	OCT	DEC	OCT
(FIL) 1 00001	(STH) 0 00000		

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

(FIL) (STH)

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC
205	18 00052	206	207	22 00104	208
210	34 00236	211	36 00244	37 00246	213
214	48 00353	215	50 00374	57 00444	217
					60 00461

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SUBROUTINE LOADS
DIMENSION NOP(24), Q(10), X(50), Y(50), ATTIT(50,2), CZRE(50,2),
1 HADD(50,2), LL(50), LH(50), CNIN(50,2), HR(50,2),
2 NCPT(50), DELY(50), ZI(50,10)
DIMENSION A(50,100), B(50,100), C(50,2), D(50,2), H(50,2),
1 F(50,2), FR(50,2), HF(50,2), HF(50,2), H(50,2), FA(50,2),
2 FFR(50,2), WCHK(50,2), ZI(2), DT(2), DD(2),
3 SHEAR(20,50), FOM(20,50), TORQU(20,50), LOW(50),
4 LHGM(50), Z(2)
EQUIVALENCE (NBP(14),NQ), (NOP(13),NEXST), (LH,X), (LL,Y),
1 (NBP(17),NRC), (NOP(23),TITL1), (NOP(24),TITL2)

COMMON NOP, X, Y, NTAPE2, NTAPE3, NTAPE4, NTAPE5, NTAPE6, NTAPE8, NNO31273
1 CBAR, FLEKK, CAPS, CAPH, CAPT, CAPN, SMALS, CAPXO, CIOKRHINO31274
2 CAPZ, CAPHO, Q, MAXR, ATTIT, CZRE, CNIN, HR, HADD,
3 NSTRP, NCPT, DELY, ZI, MAXO, NC, CNRC, A, B, C, D, H,
4 F, FR, HF, HI, FA, FFR, WCHK, ZI, Z, DT, DD, SHEAR, FOM, NNO31277
5 TORQU, LOW, HIGH, DDEN, DIMAG, DREAL, IQ, I, J, L, NVNT NNO31278
6 LHGM

400 FORMAT (1H1 35X, 25H SHEAR COEFFICIENT MATRIX )
401 FORMAT (1H0 35X, 26H MOMENT COEFFICIENT MATRIX )
402 FORMAT (1H0 35X, 26H TORQUE COEFFICIENT MATRIX )
403 FORMAT (1H1 27X, 40H LOADS FOR CONSTANT ROOT ANGLE OF ATTACK )
404 FORMAT (1H1 34X, 28H LOADS FOR TRIMMED CONDITION )
405 FORMAT (1H1 30X, 36H LOADS FOR CONSTANT LIFT COEFFICIENT )
406 FORMAT (1H0 10X, 22H AERODYNAMIC LIFT (Z)= 1E18.8 / 1H0 6X,
1 26H INCREMENTAL PITCH ANGLE = 1E18.8 )
407 FORMAT (1H 11X, 113, 1E20.8, 27X, 113, 1E20.8 )
408 FORMAT (1H 113, 2X, 2E18.8, 2H I 7X, 113, 2X, 2E18.8, 2H I )
409 FORMAT (1H0 6X, 37H FINAL AERODYNAMIC FORCE DISTRIBUTION 1 7X,
1 25H TOTAL FORCE DISTRIBUTION )
410 FORMAT (1H0 31X, 20H DYNAMIC PRESSURE = 1E16.8 )
411 FORMAT (1H0 10X, 22H AERODYNAMIC LIFT (Z)= 2E18.8, 1H1 / 1H0 6X,
1 26H INCREMENTAL PITCH ANGLE = 2E18.8, 1H1 )
412 FORMAT (1H0 17X, 17H DEFORMATION MODE 30X, 17H TOTAL DEFLECTION
1 5 H MODE )
413 FORMAT (1H0 37X, 22HSHEAR AT LOAD STATIONS / (1H 6E18.8) )
414 FORMAT (1H0 36X, 24H MOMENT AT LOAD STATIONS / (1H 6E18.8) )

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415 FORMAT (1H0 36X, 23HTORQUE AT LOAD STATIONS / (1H 6E18.8) )
416 FORMAT (1814)
417 FORMAT (6E12.8)

      REMIND NTAPE4
      REMIND NTAPES
      REMIND NTAPES

      IF (NOP(16)) 450,450,420
C  READ IN (V/F), (M/F), (T/F) MATRICES.
420 DO 432 I=1,3
      READ INPUT TAPE NTAPES2, 416, NVMT
      READ INPUT TAPE NTAPES2, 416, ((LOW(J),LHIGH(J)),J=1,NVMT)
      DO 424 J=1,NVMT
        DO 422 K=1,NRC
          A(J,K)=0.
          M=LOW(J)
          L=LHIGH(J)
424      READ INPUT TAPE NTAPES2, 417, ((A(J,K)),K=M,L)
          GOTO (426,428,430),I
426      WRITE OUTPUT TAPE NTAPES3, 400
          DO 427 J=1,NVMT
            DO 427 K=1,NRC
              SHEAR(J,K)=A(J,K)
427      NVMS=NVMT
          GOTO 432
428      WRITE OUTPUT TAPE NTAPES3, 401
          DO 429 J=1,NVMT
            DO 429 K=1,NRC
              FPM(J,K)=A(J,K)
429      NVFM=NVMT
          GOTO 432
430      WRITE OUTPUT TAPE NTAPES3, 402
          DO 431 J=1,NVMT
            DO 431 K=1,NRC
              TORQUE(J,K)=A(J,K)
431      CALL MPRINT (A,NVMT,NRC,MAXR,NTAPES3)
432

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C COMPUTE (H) COLUMN MATRIX
450 DO 454 J=1,NC
    DO 454 I=1,NRC
        H(I,J)=CAPH*HR(I,J)+CAPH*HADD(I,J)+CAPT*ATT(I,I,J)
454 READ (H) (CH) FROM TAPE NTAPES INTO A AND COMPUTE (FR)
    READ TAPE NTAPES, I(ATT,I,J),J=1,NC,NRC, I=1,NRC)
    CALL PMULTD (A,NOP(7), H,NOP(7),C,NRC,NRC, 1,MAXR,MAXR,MAXR )
    DO 459 J=1,NC
        DO 456 I=1,NRC
            DO 456 JFR(I,J)=CAPS* C(I,J) /CBAR
456 IF ( NOP(12) ) 457,459,457
457 DO 458 I=1,NRC
458 FFR(I,J)=FFR(I,J) + CAPS* CZRE(I,J)
459 CONTINUE
        IF (NOP(2)+NOP(3)) 460,478,460
460 CALL PMULTD (A,NOP(7),X,0,NCHX,NRC,NRC,1,MAXR,MAXR,MAXR )
        Z(1)=CAPZ
        Z(2)=0.
        IF ( NOP(3) ) 462,478,462
462 DO 464 J=1,NC
            DO 464 I=1,NRC
                C(I,J) = CAPH*HR(I,J)+CAPH*HADD(I,J)
464 CALL PMULTD (A,NOP(7),C,NOP(7), D ,NRC,NRC, 1,MAXR,MAXR,MAXR)
            DO 476 J=1,NC
                ZZ(J)=0.
                DO 470 I=1,NRC
                    ZZ(I)=ZZ(I)+ D(I,J)
470 IF (NOP(12)) 472,476,472
472 DO 474 I=1,NRC
                    ZZ(I) = ZZ(I)+ CZRE(I,J)
474

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476  ZZ(J)= ZZ(J)+CAPS / CBAR
478  SENSE LIGHT 0
B READ FLEXIBILITY. (A),MATRIX FROM NTAPE4 INTO B.
  READ TAPE NTAPES, ((B(I,J),J=1,NRC),I=1,NRC)
  IF INOP(1) ) 481,482,481
481  SENSE LIGHT 1
482  IF INOP(2) ) 483,484,483
483  SENSE LIGHT 2
484  IF INOP(3) ) 485,486,485
485  SENSE LIGHT 3
486  DO 554 IQ=1,NQ
      DO 488 J=1,NC
      DO 488 I=1,NRC
      FR(I,J) = Q(IQ) * FFR(I,J) +CAPN*CNIN(I,J)
C READ (A) FROM NTAPES INTO A ARRAY
  READ TAPE NTAPES, ((A(I,J),J=1,NCNRC),I=1,NRC)
  IF (SENSE LIGHT 1) 490,492
490  SENSE LIGHT 1
  CALL MMULTD (BIO,FR,NOP(7),D,NRC,NRC,1,MAXR,MAXR,MAXR)
  CALL PMULTD (A,NOP(7),D,NOP(7),HF,NRC,NRC,1,MAXR,MAXR,MAXR)
C READ (B) MATRIX INTO A.
492  READ TAPE NTAPES, ((A(I,J),J=1,NCNRC),I=1,NRC)
  CALL MMULTD (A,NOP(7),FR,NOP(7),F,NRC,NRC,1,MAXR,MAXR,MAXR)
  IF (SENSE LIGHT 1) 514,494
494  CALL MMULTD (A,NOP(7),MCHX,NOP(7),D, NRC,NRC,1,MAXR,MAXR,MAXR)
      DO 496 J=1,NC

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 HMO31412

11/30/62

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DT(J)=0.
DB(J)=0.
DB 496 I=1,NRC
DT(J)=DT(J)+F(I,J)-CAPN*CN1M(I,J)
DD(J)=DD(J)+D(I,J)
406 IF (SENSE LIGHT 2 ) 498,500

408 SENSE LIGHT2
GOTO 502

500 Z(1)=ZZ(1)*Q(IQ)
Z(2)=ZZ(2)*Q(IQ)

502 IF (NC-1) 506,504,506
504 DT(1)= (DT(1)-Z(1)) / (Q(IQ)*CAPS*DD(1) / CBAR )
DO 505 I=1,NRC
505 F(I,1)=F(I,1)-DT(1)*D(I,1)=Q(IQ)*CAPS/CBAR
GOTO 511

506 DREAL = (DT(1)-Z(1))*DD(1) + (DT(2)-Z(2))*DD(2)
DIMAG = (DT(2)-Z(2))*DD(1) - (DT(1)-Z(1))*DD(2)
DDEN = (DD(1)**2 + DD(2)**2 )
DT(1)= DREAL*CBAR / (CDEN*Q(IQ)*CAPS)
DT(2)= DIMAG*CBAR / (CDEN*Q(IQ)*CAPS)

DB 510 I=1,NRC
F(I,1)=F(I,1)-(Q(IQ)*CAPS/CBAR)* (DT(1)*D(I,1)-DT(2)*D(I,2))
510 F(I,2)=F(I,2)-(Q(IQ)*CAPS/CBAR)* (DT(1)*D(I,2)+DT(2)*D(I,1))

511 CALL PMULTD (B,0,F,0,HF,NRC,NRC,1,MAXR,MAXR,MAXR)

DO 512 J=1,NC
DB 512 I=1,NRC
HI(I,J) = FLEX*HF(I,J) + H(I,J) -DT(J)*X(I)
GOTO 518

514 SENSE LIGHT 1

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HMO31450

11/30/62

CALL PMULTD (BIO,F,NOPI7),HI,NRC,NRC,1,MAXR,MAXR,MAXR)

DO 516 J=1,NC

DO 516 I=1,NRC

510 HI(I,J)=FLBK\*HI(I,J)\*H(I,J)

518 DO 520 J=1,NC

DO 520 I=1,NRC

HF(I,J)=FLBK\*HF(I,J)

520 FA(I,J)=F(I,J)-CAPN\*CN1N(I,J)

IF ISENSE LIGHT 1 1 524,526

524 SENSE LIGHT 1

WRITE OUTPUT TAPE NTAPB3, 403

GOTO 532

526 IF ISENSE LIGHT 2 1 528,530

528 SENSE LIGHT 2

WRITE OUTPUT TAPE NTAPB3, 404

GOTO 532

530 WRITE OUTPUT TAPE NTAPB3, 405

532 WRITE OUTPUT TAPE NTAPB3, 410, Q(IQ)

IF ISENSE LIGHT 1 1 534,536

534 SENSE LIGHT 1

GOTO 542

536 IF INC-1) 540,540,538

538 WRITE OUTPUT TAPE NTAPB3, 411, ( Z(J),J=1,NC), (DT(I),J=1,NC)

GOTO 542

540 WRITE OUTPUT TAPE NTAPB3, 406, Z(1), DT(1)

542 WRITE OUTPUT TAPE NTAPB3, 412

IF INC-1) 546,544,546

544 WRITE OUTPUT TAPE NTAPB3, 407, (I,HF(I,1),I,HI(I,1),I=1,NRC)

GOTO 548

HM031451

HM031452

HM031453

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HM031488

[illegible]

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STORAGE NOT USED BY PROGRAM

DEC OCT  
1398 02566

DEC OCT  
17188 41444

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT	DEC	OCT					
A 31305	75111	ATPV	32409	77231	B 26305	63301	C1OKR	32423	77247					
CARH	32421	77245	CAPH	32428	77254	CAPN	32426	77252	CAPS	32429	77255			
CAPT	32427	77253	CAPX	32424	77250	CAPZ	32422	77246	CBAR	32431	77257			
CMN	32209	76721	C	21305	51471	CZRE	32309	77065	DDEN	17246	41536			
DB	20299	47513	DELY	31858	76162	DIMAG	17245	41535	DREAL	17244	41534			
B 21205	51325	DT	20301	47515	FA	20605	50175	FFR	20505	50031	F 21005	51015		
FLEK	32430	77256	FROM	19297	45541	FR	20905	50651	HI	20705	50341	I 17242	41532	
HAD	32809	76411	HF	20805	50505	HIGH	17247	41537	LL	32487	77347	MAXR	32410	77232
HR	32109	76555	H	21105	51161	IQ	17243	41533	NC	31307	75113	NBXT	32549	77445
J 17241	41531	LHIGH	17238	41526	L	17240	41530	MAXQ	31308	75114	NSTRP	31909	76245	
LOW	17297	41621	NCPT	31908	76244	NQ	32548	77444	NTAPE4	32435	77263	NTAPE5	32434	77262
MCRC	31906	75112	NTAPE3	32436	77264	NTAPE8	32432	77260	NVMT	17239	41527	Q	32420	77244
MR	32561	77461	NTAPE6	32433	77261	SMALS	32425	77251	TITL1	32539	77433	TITL2	32538	77432
NTARE2	32437	77265	SHEAR	20297	47511	WCHX	20405	47665	X	32537	77431	Y	32487	77347
NTARE6	20297	47511	TORQ	18297	43671	Z	20303	47517	ZZ	20305	47521			
TOREQ	18297	43671												
Z1	31808	76100												

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

DEC OCT  
N 1397 02565

DEC OCT  
NVMM 1396 02554  
NVMS 1395 02563

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

EFN	LOC	EFN	LOC	EFN	LOC
81CG	400 02544	81CH	401 02534	81CI	402 02524
81CK	404 02502	81CL	405 02471	81CM	406 02457
81CN	408 02425	81CP	409 02413	81CQ	410 02371
				81CR	411 02360

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8)CS 412 02335 8)CT 413 02317 8)CU 414 02305 8)CV 415 02273 /  
8)DO 416 02261 8)DI 417 02257

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

DEC	OCT	DEC	OCT	DEC	OCT
1) 1381 02545	2) 1186 02242	3) 1191 02247	6) 1192 02250		
C)G1 1385 02551	C)G2 1386 02552	C)G3 1387 02553	C)I02 1388 02554		
C)201 1389 02555	C)203 1390 02556	C)204 1391 02557	C)205 1392 02560		
C)206 1393 02561	C)207 1394 02562	D)24A 592 01740	D)405 66 00102		
D)505 65 00101	E)1P 432 00660				

LOCATIONS OF NAMES IN TRANSFER VECTOR

DEC	OCT	DEC	OCT	DEC	OCT
MMURTD 8 00010	MPRINT 5 00005	(FIL) 4 00004	(KLR) 7 00007		
(RTN) 2 00002	(RWT) 0 00000	(STH) 3 00003	(TSB) 6 00006		
(TSH) 1 00001					

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

MMURTD	MPRINT	(FIL)	(RLR)	(RTN)	(RWT)	(STH)	(TSB)
(TSH)							

EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
420 29 00034	422 41 00103	424 44 00114	426 50 00157					
427 53 00203	428 56 00220	429 59 00244	430 62 00261					
431 65 00305	432 66 00317	450 68 00330	454 70 00346					
456 82 00461	457 84 00472	458 85 00472	459 86 00501					
460 88 00513	462 93 00535	464 95 00553	470 101 00641					
472 103 00651	474 104 00651	476 105 00663	478 106 00677					
481 115 00727	482 116 00730	483 117 00732	484 118 00733					
485 119 00735	486 120 00736	488 123 00760	490 132 01025					
492 137 01056	494 147 01122	496 154 01165	498 156 01202					
500 158 01204	502 160 01212	504 161 01217	505 163 01233					

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506	165 01247	510	172 01350	511	173 01371	512	177 01416
514	179 01437	516	184 01472	518	185 01505	520	188 01526
524	190 01544	526	193 01552	528	194 01554	530	197 01562
532	198 01566	534	201 01577	536	203 01601	538	204 01606
540	213 01631	542	215 01641	544	217 01652	546	223 01677
548	235 01741	550	237 01752	551	245 01777	552	257 02040
553	258 02044	554	285 02212	557	288 02223	556	289 02226
558	290 02230	566	292 02232	562	293 02234	564	295 02236

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SUBROUTINE DERIV

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DIMENSION NOP(24), Q(10), X(50), Y(50), ATT(50,2), CZRE(50,2),
1 HADD(50,2), LL(50), LH(50), CNIN(50,2), HR(50,2),
2 NCPT(50), DELY(50), ZI(50,10)
DIMENSION A(50,100), B(50,100), C(50,2), D(50,2), E(50,2)

EQUIVALENCE (NOP(14),NO), (NOP(13),NEXST), (LH,X), (LL,Y),
1 (NOP(17),NRC), (NOP(23),TITL1), (NOP(24), TITL2)

COMMON NOP,X,Y,NTAPE2,NTAPE3,NTAPE4,NTAPE5,NTAPE6,NTAPE8,CBAR,
1 FLEXK,CAPS,CAPH,CAPT,CAPN,SMALS,CAPXQ,C10KR,CAPZ,CAPHQ,Q,
2 MAXR,ATTIT,CZRE,CNIN,HR,HADD,NSTRP,NCPT,DELY,ZI,MAXQ,NC,
3 NCMRC,A,B,C,D,H,E,NX,TRASH

6 FORMAT(1H138(1H 120)INITIAL COEFFICIENTS)
7 FORMAT(1H134(1H 133)AERODYNAMIC STABILITY DERIVATIVES)
8 FORMAT(1H133(1H 129)THERMAL STABILITY DERIVATIVES)
9 FORMAT (53H0*****DISTRIBUTED FORCE COEFFICIENTS (DYNAM
1 14HC PRESSURE = 1E15.8, 1H) / )
10 FORMAT(1H137(1H 120)INERTIAL DERIVATIVES)
11 FORMAT (1H 28X, 36H)ADDITIONAL DEFLECTION MODE (H/REF H) / )
12 FORMAT (1H 36X, 5H REAL // (1H 24X, 116, 3X, 1E18.8) )
13 FORMAT (1H 35X, 7H)COMPLEX // (1H 15X, 116, 3X, 2E18.8, 1H))

REWIND NTAPE4
REWIND NTAPES
REWIND NTAPE8
SENSE LIGHT 0
NX=0

C TEST FOR OPTION 5,6,7,8,9 AND SET SLS ACCORDINGLY.
IF (NOP(5)) 24,24,23
23 SENSE LIGHT 1

24 IF (NOP(6)) 26,26,25
25 SENSE LIGHT 2

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HM031562  
HM031563  
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HM031597  
HM031598

26 IF (NOP(8)) 28,28,27  
27 SENSE LIGHT 3

28 IF (NOP(9)) 30,30,29  
29 SENSE LIGHT 4

C THEN PROCEED TO (C) COMPUTATIONS.

30 IF (SENSE LIGHT 1) 31,34  
31 SENSE LIGHT 1  
WRITE OUTPUT TAPE NTAPE3, 6  
DO 32 I=1,NC

DO 32 J=1,NRC  
32 D(J,I) = (CAPHO) =HR(J,I)  
GOTO 45

34 IF (SENSE LIGHT 2) 35,38  
35 SENSE LIGHT 2  
WRITE OUTPUT TAPE NTAPE3, 7  
DO 36 I=1,NC

DO 36 J=1,NRC  
36 D(J,I) = MACD(J,I)  
GOTO 45

38 IF (SENSE LIGHT 3) 39,42  
39 SENSE LIGHT 3  
WRITE OUTPUT TAPE NTAPE3, 8  
DO 40 I=1,NC

DO 40 J=1,NRC  
40 D(J,I) = ATTRIT(J,I)  
GOTO 45

42 IF (SENSE LIGHT 4) 43,67  
43 SENSE LIGHT 4  
WRITE OUTPUT TAPE NTAPE3, 10

C READ FLEXIBILITY MATRIX FROM TAPE (A)  
READ TAPE NTAPE4, ((A(I,J),J=1,NRC),I=1,NRC)

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HM031600  
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CALL PHULTD ( A,O,CNIN,NOP(7),D,NRC,NRC,1, MAXR,MAXR,MAXR)
DO 44 I=1,NC
  DO 44 J=1,NRC
    44 E(J,I) = FLEXX*D(J,I) / CBAR

C READ AERO. MATRIX FROM TAPE (W) (CH)
READ TAPE NTAPES, ((B(I,J),J=1,NCNRC),I=1,NRC)
NX=1
GOTO 50
45 READ TAPE NTAPES, ((A(I,J),J=1,NCNRC),I=1,NRC)
CALL PHULTD ( A,NOP(7),D,NOP(7),C,NRC,NRC,1, MAXR,MAXR,MAXR)
DO 46 I=1,NC
  DO 46 J=1,NRC
    46 C(J,I)=C(J,I)/CBAR
  IF (SENSE LIGHT 1) 47,50
47 SENSE LIGHT 1
  IF (NOP(12)) 50,50,48
48 DO 49 I=1,NC
  DO 49 J=1,NRC
    49 C(J,I)= C(J,I)+CZRE(J,I)

C START COMPUTATIONS FOR EACH DYNAMIC PREASURE, Q.
50 DO 60 IQ=1,NQ

  READ TAPE NTAPES, ((A(I,J),J=1,NCNRC),I=1,NRC)
  IF ( Q(IQ) ) 51,51,53
51 IF ( NX ) 71,71,54
71 DO 52 J=1,NC
  DO 52 I=1,NRC
    52 D(I,J) = C(I,J)
  GOTO 55
53 IF ( NX ) 56,56,54
54 CALL PHULTD ( A,NOP(7),E,NOP(7),C,NRC,NRC,1, MAXR,MAXR,MAXR)
55 CALL PHULTD ( B,NOP(7),C,NOP(7),D,NRC,NRC,1, MAXR,MAXR,MAXR)
55 READ TAPE NTAPES, TRASH
GOTO 57

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56 READ TAPE NTAPE3, ((A(I,J),J=1,NCNRC),I=1,NRC)
57 CALL PHULTD ( A,NOP(7),C,NOP(7),D,NRC,NRC,1, MAXR,MAXR,MAXR)
58 WRITE OUTPUT TAPE NTAPE3, 9, Q(IQ)
59 IF (NC-1) 58,58,59
60 WRITE OUTPUT TAPE NTAPE3, 12, (J,D(J,1),J=1,NRC)
61 GOTO 70
62 WRITE OUTPUT TAPE NTAPE3, 13, (J,(D(J,1),I=1,NC),J=1,NRC)
70 CALL CENTER (D)
60 CONTINUE
REWIND NTAPE4
REWIND NTAPES
REWIND NTAPE8
61 IF (SENSE LIGHT 1 ) 34,61
62 IF (SENSE LIGHT 2 ) 62,66
63 NOP(6)=NOP(6)-1
64 IF (NOP(6)) 38,38,63
65 SENSE LIGHT 2
66 CALL MREAD (D,NRC,NC,1,0,0,0,A,MAXR,NTAPE2,NTAPE3 )
67 WRITE OUTPUT TAPE NTAPE3, 7
68 WRITE OUTPUT TAPE NTAPE3, 11
69 IF (NC-1) 64,64,65
70 WRITE OUTPUT TAPE NTAPE3, 12, (I,D(I,1),I=1,NRC)
71 GOTO 45
72 WRITE OUTPUT TAPE NTAPE3, 13, (I,(D(I,J),J=1,NC),I=1,NRC)
73 GOTO 45
66 IF ( SENSE LIGHT 3 ) 42,67
67 RETURN
END(1,0,0,0,0,C,0,0,0,1,0,0,0,0,0)

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 HMO31667  
 HMO31668

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STORAGE NOT USED BY PROGRAM

DEC OCT  
681 01251

DEC OCT  
21002 51012

STORAGE LOCATIONS FOR VARIABLES APPEARING IN COMMON STATEMENTS

DEC OCT  
A 31305 75111  
CAPHC 32421 77245  
CAPT 32427 77253  
CM1N 32209 76721  
C 21205 51325  
HR 32109 76555  
MAXQ 31308 75114  
NC 31307 75113  
NRC 32545 77441  
NTAPE4 32435 77263  
NX 21004 51014  
TITL2 32538 77432  
ZI 31808 76100

DEC OCT  
ATTIT 32409 77231  
CAPN 32428 77254  
CAPXO 32424 77250  
C 21305 51471  
E 21104 51160  
H 21105 51161  
MAXR 32410 77232  
NEXST 32549 77445  
NSTRP 31909 76245  
NTAPE5 32434 77262  
Q 32420 77244  
TRASH 21003 51013

DEC OCT  
B 26305 63301  
CAPN 32426 77252  
CAPZ 32422 77246  
CZRE 32309 77065  
FLEXK 32430 77256  
LH 32537 77431  
NCNRC 31306 75112  
NOP 32561 77461  
NTAPE2 32437 77265  
NTAPE6 32433 77261  
SMALS 32425 77251  
X 32537 77431

DEC OCT  
C1OKR 32423 77247  
CAPS 32429 77255  
CBAR 32431 77257  
DELY 31858 76162  
HADD 32009 76411  
LL 32487 77347  
NCPT 31908 76244  
NQ 32548 77444  
NTAPE3 32436 77264  
NTAPE8 32432 77260  
TITL1 32539 77433  
Y 32487 77347

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

DEC OCT  
I 680 01250

DEC OCT  
J 679 01247

SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

EFN LOC  
816 6 01246  
81A 10 01176

EFN LOC  
817 7 01240  
818 11 01170  
81C 12 01156  
819 9 01220  
81D 13 01145

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

	DEC	OCT	DEC	OCT
2)	595	01123		
6)	598	01126		

## LOCATIONS OF NAMES IN TRANSFER VECTOR

DEC		OCT		DEC		OCT		DEC		OCT	
CENTER	6	00006	MULTD	5	00005	MREAD	7	00007	(FIL)	2	00002
(RIR)	4	00004	(RWT)	0	00000	(STH)	1	00001	(TSB)	3	00003

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

CENTER	MMIII TO	MBREAD	(FIL)	(RLR)	(RWT)	(STH)	(TSB)
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12
13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14
15	15	15	15	15	15	15	15
16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18
19	19	19	19	19	19	19	19
20	20	20	20	20	20	20	20
21	21	21	21	21	21	21	21
22	22	22	22	22	22	22	22
23	23	23	23	23	23	23	23
24	24	24	24	24	24	24	24
25	25	25	25	25	25	25	25
26	26	26	26	26	26	26	26
27	27	27	27	27	27	27	27
28	28	28	28	28	28	28	28
29	29	29	29	29	29	29	29
30	30	30	30	30	30	30	30
31	31	31	31	31	31	31	31
32	32	32	32	32	32	32	32
33	33	33	33	33	33	33	33
34	34	34	34	34	34	34	34
35	35	35	35	35	35	35	35
36	36	36	36	36	36	36	36
37	37	37	37	37	37	37	37
38	38	38	38	38	38	38	38
39	39	39	39	39	39	39	39
40	40	40	40	40	40	40	40
41	41	41	41	41	41	41	41
42	42	42	42	42	42	42	42
43	43	43	43	43	43	43	43
44	44	44	44	44	44	44	44
45	45	45	45	45	45	45	45
46	46	46	46	46	46	46	46
47	47	47	47	47	47	47	47
48	48	48	48	48	48	48	48
49	49	49	49	49	49	49	49
50	50	50	50	50	50	50	50
51	51	51	51	51	51	51	51
52	52	52	52	52	52	52	52
53	53	53	53	53	53	53	53
54	54	54	54	54	54	54	54
55	55	55	55	55	55	55	55
56	56	56	56	56	56	56	56
57	57	57	57	57	57	57	57
58	58	58	58				

### EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
23	21	00036	24	22	00037	25	23	00043	26	24	00044
27	25	00050	28	26	00051	29	27	00055	30	28	00056
31	29	00060	32	33	00103	34	35	00116	35	36	00120
36	40	00143	38	42	00155	39	43	00157	40	47	00202
42	49	00214	43	50	00216	44	63	00302	45	73	00345
46	84	00424	47	86	00440	48	88	00445	49	90	00463
50	91	00475	51	100	00530	71	101	00533	52	103	00551
53	105	00563	54	106	00567	55	110	00617	56	113	00625
57	122	00666	58	125	00700	59	131	00721	70	138	00756
60	140	00760	61	145	00773	62	146	00775	63	148	01004
64	154	01035	65	160	01056	66	168	01114	67	169	01117

MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

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C CALLING SEQUENCE.....

C A = MATRIX, DIMENSIONED (MAXR X N) - REAL  
 C (MAXR X 2\*N) - COMPLEX  
 C NTAPE=UTILITY TAPE, IF + MATRIX IS IN CORE AT A, IF - ITS ON NTAPE  
 C N = ORDER OF MATRIX  
 C GUESS=1ST. GUESS VECTOR, DIMENSIONED (MAXR X 1) - REAL  
 C (MAXR X 2) - COMPLEX  
 C NGUESS=0, ROUTINE SUPPLIES GUESS VECTOR  
 C =+1, GUESS CONTAINS GUESS VECTOR  
 C NMODE=NUMBER OF EIGEN SOLUTIONS REQUESTED.  
 C VECTOR=EIGENVECTORS, DIMENSIONED (MAXR X NMODE) - REAL  
 C (MAXR X 2\*NMODE) - COMPLEX  
 C EIGVAL=EIGENVALUES  
 C (NMODE X 1) - REAL  
 C (NMODE\*2 X 1) - COMPLEX  
 C NITER=NUMBER OF ITERATIONS PER MODE  
 C NITRSP = MAXIMUM NUMBER OF SINGLE PRECISION ITERATIONS  
 C EPS = CONVERGENCE CRITERIA  
 C IR = ERROR INDICATOR  
 C US=CHECK EIGENVECTORS, DIMENSIONED (MAXR X NMODE) - REAL  
 C (MAXR X 2\*NMODE) - COMPLEX  
 C H = WORKING AREA OF CORE, DIMENSIONED (MAXR X (NMODE+2)) - REAL  
 C (MAXR X 2\*(NMODE+2)) - COMPLEX  
 C WILL CONTAIN CHECK EIGENVALUES, IF REQUESTED.  
 C NTAPE1=TAPE NUMBER OF OUTPUT PRINT TAPE  
 C IF = 0, NO RESULTS WILL BE PRINTED  
 C MAXR = DIMENSIONED NUMBER OF ROWS  
 C NC = 1, PROBLEM REAL  
 C = 2, PROBLEM COMPLEX  
 C AITKEN = AITKEN COVERAGE CRITERIA  
 C NAKSR = NUMBER OF TIMES AITKEN APPLIED IN EACH MODE

SUBROUTINE MITER (A, NTAPE, N, GUESS, NGUESS, NMODE, VECTOR,  
 EIGVAL, NITER, NITRSP, EPS, IR, US, H,  
 1

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MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

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```

2      MAXR, NC, AITKEN, NAKSR, NTAPE1 )
      DIMENSION A(1), GUESS(1), VECTOR(1), EIGVAL(1), NITER(1), US(1),
1      H(1), NAKSR(1), 800LT(4)
      800LT(1)=606046652551
      800LT(2)=264346666060
      800LT(3)=243165312425
      800LT(4)=602330252342
      IF ACCUMULATOR OVERFLOW      3,3
3      IF DIVIDE CHECK      4,4
C FIND MATRIX AND STORE ON TAPE IF NECESSARY
4      I=NTAPE
      J2=MAXR*NC*N
      IF ( I ) 5,8,6
5      I=-1
      REWIND 1
      DO 1 J=1,N
1      READ TAPE 1, (A(K),K=J,J2,MAXR)
      NTAPE = I
      GOTO 7
6      REWIND NTAPE
      DO 2 J=1,N
2      WRITE TAPE NTAPE, (A(K),K=J,J2,MAXR)
7      REWIND NTAPE
C DEFINE PROGRAM CONSTANTS AND ZEROS.
8      MODE=0
      IR=0
      AT=AITKEN**2
      IF ( EPSP ) 12,9,12
9      EPSP = .1E-08
12     IF ( NGUESS ) 15,13,15
13     J1=MAXR*(NC-1)

```

HMO31709  
 HMO31710  
 HMO31711  
 HMO31712  
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 HMO31746

MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

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```

      DO 14 I=1,N
        K=J1+1
        GUESS(K)=0.
      14 GUESS(I)=1.

      15 MUDE = MODE+1
      NAKSR(MUDE)=0
      IGO=1
      NITER(MUDE)=0
      K1=NC*MAXR*(MUDE-1)
      K2=K1+1
      K3=NC*(MUDE-1)+1
      K4= NC*MAXR
      K5=K4*NMUDE
      K6=K5+K4

      C MOVE FIRST GUESS INTO POSITION
      DO 16 J=1,NC
        J1=MAXR*(J-1)
      DO 16 I=1,N
        K=K1+J1+1
        L=J1+1
        H(K)=GUESS(L)
      16 NAK=0
      17 NAK=0
      18 NITER(MUDE)=NITER(MUDE)+1
      NAK=NAK+1
      INDEX=0
      CALL MMULTO (A,NC-1,H(K2),NC-1,VECTOR(K2),N,N,1,MAXR,MAXR,MAXR)
      CALL NPNRMX (VECTOR(K2), H(K2), N, EIGVAL(K3), INDEX, MAXR, NC,1)

      C TEST FOR SINGLE ROOT CONVERGENCE
      DO 23 J=1,NC
        J1=(J-1)*MAXR
        K=K1+J1
      GOTO (24,19,21),NAK
      19 L=K5+J1
      DO 20 I=1,N

```

HMO31747  
 HMO31748  
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 HMO31784

MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

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```

L=L+1
K=K+1
IF ( ABSF(H(L)-H(K)) - EPSP) 20,20,24
20 CONTINUE
GOTO 100
21 DO 22 I=1,N
K=K+1
IF ( ABSF(US(K)-H(K)) - EPSP) 22,22,24
22 CONTINUE
23 CC CONTINUE
100 IF ACCUMULATOR OVERFLOW 108,102
102 IF DIVIDE CHECK 104,56
104 NP=3
GOTO 109

C NO CONVERGENCE, SO TEST MAXIMUM NUMBER OF ITERATIONS.
24 IF ( NITER(MODE)-NITRSP ) 25,100,100
25 GOTO (40,44,31),NAK

C NOT YET EXCEEDED, SO TRY FOR AITKENS TIME.

C TEST FOR AITKENS CONVERGENCE.
31 GOTO (26,36),NC

26 DO 28 I=1,N
J=K5+1
K=K1+1
IF ( US(K)-H(J) ) 27,28,27
27 IF ( ABSF( H(K)-US(K)) / ( US(K)-H(J)) ) - AITKEN ) 28,28,32
28 CONTINUE

C ALL VECTOR ELEMENTS OK, SO APPLY AITKENS SPEEDER-UPPER.
DO 30 I=1,N
J=K5+1
K=K1+1
Q=(H(K)-2.*US(K)+H(J))
IF ( Q ) 29,30,29

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HMO31785  
HMO31786  
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HMO31799  
HMO31800  
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HMO31821  
HMO31822

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MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

29 H(K)=H(J)- ( (US(K)-H(J))\*\*2 / Q)  
30 CONTINUE  
NAKSR(MODE)=NAKSR(MODE) + 1  
GOTO 17

C CONVERGENCE TEST NOT MET. RESTORE AND TRY AGAIN.

32 DO 33 J=1,NC  
J1=MAXR\*(J-1)  
DO 33 I=1,N  
J=K1+J1+I  
K=K5+J1+I  
H(K)=US(J)  
33 US(J)=H(J)  
NAK=2  
GOTO 18

C IF PROBLEM COMPLEX, REPEAT ALL ABOVE FOR COMPLEX ARITHMETIC.

36 DO 38 I=1,N  
J=K5+I  
K=K1+I  
JJ=J+MAXR  
KK=K+MAXR  
Q = (US(K)-H(J))\*\*2 + (US(KK)-H(JJ))\*\*2  
IF ( Q ) 37,38,37  
37 IF ( (H(K)-US(K))\*\*2 + (H(KK) - US(KK))\*\*2 ) / Q-AT) 38,38,32  
38 CONTINUE  
DO 39 I=1,N  
J=K5+I  
JJ=J+MAXR  
K=K1+I  
KK=K+MAXR  
Q = (H(K)-2.\*US(K)+H(J))\*\*2 + (H(KK)-2.\*US(KK)+H(JJ))\*\*2  
IF ( Q ) 35,39,35  
35 X=H(K)  
H(K)= H(J) - ( ((US(K)-H(J))\*\*2-(US(KK)-H(JJ))\*\*2)\*(H(K)-2.\*

HM031823  
HM031824  
HM031825  
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HM031860

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MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

```

1      US(K)+H(J))+(2.*(US(K)-H(J))*(US(KK)-H(JJ)))*
2      (H(KK)-2.*US(KK)+H(JJ))) / Q )
      H(KK)=H(JJ)-(((2.*(US(K)-H(J))*(US(KK)-H(JJ)))+(X
1      US(K)+H(J))-(US(K)-H(J))*2-(US(KK)-H(JJ))*2)
2      *(H(KK)-2.*US(KK)+H(JJ))) / Q )
39 CONTINUE
      NAKSR(MODE) = NAKSR(MODE) + 1
      GOTO 17
40 DO 41 J=1,NC
      J1=MAXR*(J-1)
      DO 41 I=1,N
      K=K1+J1+I
      L=K5+J1+I
      H(L)=H(K)
41 GOTO (18,56),IGO
44 DO 45 J=1,NC
      J1=MAXR*(J-1)
      DO 45 I=1,N
      K=K1+J1+I
      US(K)=H(K)
45 GOTO 18
56 DO 58 J=1,NC
      J1=MAXR*(J-1)+INDEX
      DO 58 I=1,N
      K=K1+MAXR*(J-1)+I
      US(K)=A(J),
      J1=J1+K4
58 CALL SWEEPX (VECTOR,A,H,US,EIGVAL,MODE,N,MAXR,NC,INDEX,EPS)
      IF ACCUMULATOR OVERFLOW 108,106
106 IF DIVIDE CHECK 107,59
107 IF (NTAPE1) 119,118,119
118 IR=MODE
      GOTO 120

```

HMO31861  
 HMO31862  
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 HMO31897  
 HMO31898

MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

```

119 WRITE OUTPUT TAPE NTAPE1, 131, 800LT(3),800LT(4)
WRITE OUTPUT TAPE NTAPE1, 134, MODE
120 DO 125 I=1,NC
    K=K1+MAXR*(I-1)
    DO 125 J=1,N
        K=K+1
        VECTOR(K)=0.
59 J1=(NC-1)*MAXR+INDEX
    GUESS(J1)=0.
    GUESS(1)=0.
125
62 IF (NMODE=MODE) 70,70,15
108 NP=1
109 IR=MODE
    IF ( NTAPE1 ) 121, 70,121
121 WRITE OUTPUT TAPE NTAPE1, 131, 800LT(NP) ,800LT(NP+1)
    MODE=MODE-1
    WRITE OUTPUT TAPE NTAPE1, 132, MODE
70 IF ( NTAPE ) 71,75,71
71 DO 73 J=1,N
73 READ TAPE NTAPE, (A(I),I=J,J2,MAXR)
    CALL MMULTD (A,NC-1,VECTOR,NC-1,US,N,MODE ,MAXR,MAXR,MAXR)
    J=1
    K=1
    CO 72 I=1,MODE
    INDEX=0
    CALL NPNRMX (US(J),US(J),N,H(K),INDEX,MAXR,NC,1)
    J=J+K4
72 K=K+NC
75 IF ( NTAPE1 ) 92,92,80
80 WRITE OUTPUT TAPE NTAPE1, 95
DO 86 I=1,MODE
IF ( NITER(I)-NITRSP ) 85,87,87

```

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HMO31899  
 HMO31900  
 HMO31901  
 HMO31902  
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 HMO31904  
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 HMO31936

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MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

```

87 WRITE OUTPUT TAPE NTAPE1, 94, I
85 GOTO (83,84),NC
83 WRITE OUTPUT TAPE NTAPE1, 97, (I,EIGVAL(I), NITER(I), NAKSR(I))
   GOTO 86
84 L=2*I-1
   WRITE OUTPUT TAPE NTAPE1, 96, (I,EIGVAL(L),EIGVAL(L+1),NITER(I),
1   NAKSR(I) )
86 CONTINUE
   IF (I MODE ) 92,92,88
88 WRITE OUTPUT TAPE NTAPE1, 98
   L=MODE*NC
   CALL MPRINT (VECTOR,N,L,MAXR,NTAPE1)
   IF ( NTAPE ) 92,92,90
90 WRITE OUTPUT TAPE NTAPE1, 99
   WRITE OUTPUT TAPE NTAPE1, 93, (H(I),I=1,L)
   CALL MPRINT (US,N,L,MAXR,NTAPE1)
92 RETURN
93 FORMAT ( 1H 6E16.8 )
94 FORMAT (5H MODE 114, 40H HAS NOT CONVERGED IN MAXIMUM ITERATIONS)
95 FORMAT (1H 5X, 6H MODE 13X, 11H EIGENVALUE 19X,
1   11H ITERATIONS 6X, 9H AITKENS /// )
96 FORMAT (1H 1111, 2E19.8, 119, 119 )
97 FORMAT (1H 1111, 9X, 1E20.8, 9X, 119, 119 )
98 FORMAT (1H0 /// 1H0 46X, 14H EIGENVECTORS /// )
99 FORMAT (1H0 /// 1H0 36H CHECK EIGENVALUES AND EIGENVECTORS )
131 FORMAT (35H ERROR IN ITERATION SUBROUTINE...( 2A6, 1H) )
132 FORMAT (25H+ CALCULATION TERMINATED. 116,19H MODES ARE CORRECT.)
134 FORMAT (14H+ IN TRUE MODE 116, 27H CALCULATION. MODIFIED MODE
1   12H IS CORRECT. )
   END(1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)

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HMO31937  
 HMO31938  
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 HMO31946  
 HMO31947  
 HMO31948  
 HMO31949  
 HMO31950  
 HMO31951  
 HMO31952  
 HMO31953  
 HMO31954  
 HMO31955  
 HMO31956  
 HMO31957  
 HMO31958  
 HMO31959  
 HMO31960  
 HMO31961  
 HMO31962  
 HMO31963  
 HMO31964  
 HMO31965

# MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

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## STORAGE NOT USED BY PROGRAM

DEC OCT  
1795 03403  
32561 77461

## STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

DEC OCT DEC OCT DEC OCT  
800LT 1794 03402

## STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

DEC OCT	DEC OCT	DEC OCT	DEC OCT
AT 1790 03376	IGO 1789 03375	INDEX 1788 03374	I 1787 03373
J1 1786 03372	J2 1785 03371	JJ 1784 03370	J 1783 03367
K1 1782 03366	K2 1781 03365	K3 1780 03364	K4 1779 03363
K5 1778 03362	K6 1777 03361	KK 1776 03360	K 1775 03357
L 1774 03356	MODE 1773 03355	NAK 1772 03354	NP 1771 03353
Q 1770 03352	X 1769 03351		

## SYMBOLS AND LOCATIONS FOR SOURCE PROGRAM FORMAT STATEMENTS

EFN LOC	EFN LOC	EFN LOC
812T 93 03301	812U 94 03276	812V 95 03264
8131 97 03232	8132 98 03223	8133 99 03213
8144 132 03167	8146 134 03155	

## LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

DEC OCT	DEC OCT	DEC OCT
1) 1732 03304	2) 1612 03114	3) 1616 03120
6) 1625 03131	9) 1730 03302	C1G1 1742 03316
C1G3 1744 03320	C1G4 1745 03321	C1G5 1746 03322
C1G7 1748 03324	C1G8 1749 03325	C1G9 1750 03326
C1G8 1752 03330	C1G9 1753 03331	C1G0 1754 03332
C1G6 1756 03334	C1203 1757 03335	C1204 1758 03336
C1206 1760 03340	C1207 1761 03341	C1208 1762 03342
C1208 1764 03344	C1200 1765 03345	C120F 1766 03346
		4) 32767 77777
		C1G2 1743 03317
		C1G6 1747 03323
		C1G4 1751 03327
		C1G5 1755 03333
		C1205 1759 03337
		C120A 1763 03343
		C120H 1767 03347

**MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.**

[illegible]

### LOCATIONS OF NAMES IN TRANSFER VECTOR

DEC		UCT		DEC		UCT		DEC		UCT	
MMULTD	5 00005	MPRINT	10 00012	NPNRMX	6 00006	SWEEPX	7 00007				
(FIL)	9 00011	(RLR)	2 00002	(RWT)	0 00000	(STH)	3 00003				
(STH)	8 00010	(TSB)	1 00001	(WLR)	4 00004						

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

MMULTD (STH)	MPRINT (TSB)	NPRMX (WLR)	SWEEPX	(FIL)	(RLR)	(RWT)	(STB)
-----------------	-----------------	----------------	--------	-------	-------	-------	-------

### EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS

EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC	EFN	IFN	LOC
3	20	00501	4	21	00503	5	24	00517	1	27	00532
6	34	00560	2	36	00571	7	41	00614	8	42	00620
9	46	00635	12	47	00637	13	48	00643	14	52	00670
15	53	00677	16	68	01017	17	69	01033	18	70	01040
19	81	01170	20	86	01231	21	88	01242	22	91	01270
23	92	01173	100	93	01302	102	95	01305	104	96	01310

MATRIX ITERATION SUBROUTINE, REAL OR COMPLEX.

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24	98	01317	25	99	01323	31	100	01330	26	101	01332
27	105	01352	28	106	01371	29	112	01425	30	113	01442
32	116	01460	33	122	01524	36	125	01542	37	132	01614
38	133	01640	35	141	01727	39	144	02061	40	147	02073
41	152	02135	44	154	02153	45	158	02207	56	160	02222
58	165	02265	106	170	02331	107	171	02334	118	172	02340
119	174	02343	120	178	02371	125	182	02420	59	183	02431
62	186	02447	108	187	02456	109	188	02462	121	190	02466
70	195	02525	71	196	02527	73	197	02534	72	211	02654
75	212	02670	80	213	02674	87	216	02716	85	218	02733
83	219	02737	84	223	02760	86	227	03010	88	229	03017
90	234	03050	92	242	03110						

11/02/62

SINGLE CR DOUBLE PRECISION, REAL OR COMPLEX VECTOR NORMALIZATION.

```

C      CALL NPNRMX(A, B, N, FL, INDEX, MC, NX, NP )
C      A=VECTOR TO BE NORMALIZED      B=NCNORMALIZED VECTOR(MAY=A)
C      N=SIZE                          FL=NCNORMALIZING NUMBER
C      INDEX=+ CN ENTRY, NORMALIZE ON NUMBER WHOSE INDEX IS INDEX
C      =0 ON ENTRY, NORMALIZE ON LARGEST S.H. AND SET
C      INDEX=TC ITS INDEX.
C      =- CN ENTRY, NORMALIZE CN FL.
C      MC=SINGLE PRECISION DIMEANSED NUMBER OF ROWS CF A AND B
C      NX=1, VECTOR REAL
C      =2, VECTOR COMPLEX
C      NP=1, SINGLE PRECISION
C      =2, DCURLE PRECISION
C
C      SUBROUTINE NPNRMX (A, B, N, FL, INDEX, MC, NX, NP )
D      DIMENSION A(1), B(1), FL(1), D(1), C(1)
C
C      N1=1+NP
C      N2=N+NP
C      N4=MC+NP
C      IF ( INDEX ) 32, 7, 38
C      7 GO TO (11, 8), NX
C      8 FL= (A(1)+2+A(N4+1)+*2)
C      INDEX=1
C      DO 10 K=N1, N2, NP
C      I=K+N4
C      C= (A(K)+*2+A(I)+*2)
C      IF ( FL-C ) 5, 9, 1C
C      9 FL=D
C      INDEX=K
C      10 CCATINUE
C      6 FL=A(INDEX)
C      GO TO (18, 25), NP
C      11 FL=ABSF(A(1))
C      INDEX=1
C      DO 13 K=N1, N2, NP

```

SINGLE OR DOUBLE PRECISION, REAL OR COMPLEX VECTOR NORMALIZATION. 11/02/62

```

C=ABS(A(K))
IF (FL-C) 12,12,13
12 FL=C
INDEX=K
13 CONTINUE
14 FL=A(INDEX)
GOTO (16,21),NP
16 CC 17 I=1,N
17 B(I)=A(I)/FL
GOTO 30
18 I=INDEX+MC
FL(2)=A(I)
19 C=FL(1)**2+FL(2)**2
CC 20 I=1,N
K=I+MC
C=A(I)*FL(2)-A(K)*FL(1)
B(I)=(A(I)*FL(1)+A(K)*FL(2))/D
20 B(K)=-C/D
GOTO 30
21 FL(2)=A(INDEX+1)
23 CC 24 I=1,N2,NP
C 24 B(I)=A(I)/FL
GOTO 28
25 FL(2)=A(INDEX+1)
I=INDEX+N4
FL(3)=A(I)
C 26 C=FL(1)**2+FL(3)**2
CC 27 I=1,N2,NP
K=I+N4
C=A(I)*FL(3)-A(K)*FL(1)
D 3(1)=(A(I)*FL(1)+A(K)*FL(3))/D
C 27 B(K)=-C/D
28 INDEX=INDEX/2+1

```

HMQ31585  
 HMQ31586  
 HMQ31587  
 HMQ31588  
 HMQ31589  
 HMQ31590  
 HMQ31591  
 HMQ31592  
 HMQ31593  
 HMQ31594  
 HMQ31595  
 HMQ31596  
 HMQ31597  
 HMQ31598  
 HMQ31599  
 HMQ32000  
 HMQ32001  
 HMQ32002  
 HMQ32003  
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 HMQ32007  
 HMQ32008  
 HMQ32009  
 HMQ32010  
 HMQ32011  
 HMQ32012  
 HMQ32013  
 HMQ32014  
 HMQ32015  
 HMQ32016  
 HMQ32017  
 HMQ32018  
 HMQ32019  
 HMQ32020  
 HMQ32021  
 HMQ32022

11/02/62

SINGLE OR DOUBLE PRECISION, REAL OR COMPLEX VECTOR NORMALIZATION.

HM032023  
HM032024  
HM032025  
HM032026  
HM032027  
HM032028  
HM032029  
HM032030  
HM032031  
HM032032

30 RETURN

32 GOTO (34,36), NX

34 GOTO (16,23), NP

36 GOTO (19,26), NP

38 GOTO (40,39), NP

39 INDEX=2+INDEX-1

40 GOTO (14,6), NX

END(1,C)

SINGLE OR DOUBLE PRECISION, REAL OR COMPLEX VECTOR NORMALIZATION. 11/02/62

STORAGE NOT USED BY PROGRAM

DEC OCT  
590 01116  
32561 77461

STORAGE LOCATIONS FOR VARIABLES APPEARING IN DIMENSION AND EQUIVALENCE STATEMENTS

DEC OCT  
C 587 01113 D 589 01115  
DEC OCT DEC OCT DEC OCT

STORAGE LOCATIONS FOR VARIABLES NOT APPEARING IN COMMON, DIMENSION, OR EQUIVALENCE STATEMENTS

DEC OCT  
I 585 01111 K 584 01110 N1 583 01107 N2 582 01106  
N4 581 01105  
DEC OCT DEC OCT

LOCATIONS FOR OTHER SYMBOLS NOT APPEARING IN SOURCE PROGRAM

DEC OCT  
1) 571 01073  
9) 568 01070  
C164 578 01102  
C1107 251 00373  
C110M 357 00345  
D1607 248 00370  
E1V 536 01030  
DEC CCT  
2) 560 01060  
C160 575 01077  
C165 579 01103  
D1120 287 00437  
D1160 531 01023  
E12 200 00310  
E112 545 01041  
DEC CCT  
4) 32767 77777  
C162 576 01100  
C166 580 01104  
D110E 295 00447  
C1214 556 01054  
E15 243 00363  
E110E 292 00444  
DEC OCT  
6) 562 01062  
C163 577 01101  
D1193 220 00334  
C1101 312 00470  
D1407 249 00371  
E16 247 00367

LOCATIONS OF NAMES IN TRANSFER VECTOR

DEC OCT  
DEXP12 1 00001  
(CFSB) 4 00004  
DEC CCT  
(DFAC) 2 00002 (CFDP) C 00000 (CFMP) 3 00003  
DEC OCT

ENTRY POINTS TO SUBROUTINES NOT OUTPUT FROM LIBRARY

11/02/62

SINGLE CR DOUBLE PRECISION, REAL CR COMPLEX VECTOR NORMALIZATION.

DEXP(2	(CFAD)	(CFDP)	(CFMP)	(DFS8)	EXTERNAL FORMULA NUMBERS WITH CORRESPONDING INTERNAL FORMULA NUMBERS AND OCTAL LOCATIONS									
EFN	IFA	LCC	EFN	IFA	LCC	EFN	IFA	LCC	EFN	IFA	LCC	EFN	IFA	LCC
7	8	00305	8	9	00311	9	15	00354	10	17	00364	11	17	00364
6	18	00374	11	20	00401	12	25	00425	13	27	00433	14	27	00433
14	28	00440	16	30	00450	17	31	00453	18	33	00461	19	33	00461
15	35	00471	20	40	00531	21	42	00542	22	43	00546	23	43	00546
24	44	00553	25	46	00574	26	49	00612	27	54	00760	28	54	00760
28	55	01011	30	56	01024	32	58	01031	34	59	01033	35	59	01033
36	60	01036	38	61	01042	39	62	01045	40	63	01055	41	63	01055

11/12/62

SUBROUTINE DIVERG

```

DIMENSION NPO(24), C(10), X(50), Y(50), ATIT(50,2), CZRE(50,2),
1 PADD(50,2), LL(50), LH(50), CAIN(50,2), PR(50,2),
2 NCPT(50), DELY(50), ZI(50,10)
DIMENSION A(50,50), B(50,50), C(50,50), G(50), EIGVAL(50),
1 NITER(50)

EQUIVALENCE (NOP(14),AC), (NOP(13),NEXST), (LH,X), (LL,Y),
1 (NOP(17),NRC), (NOP(4),NMDE), (NOP(23),TITL1),
2 (NOP(24),TITL2)
COMMON NOP,X,Y,NTAPE2,NTAPE3,NTAPE4,NTAPE5,NTAPE6,NTAPE8,NTAPE9,CBAR,
1 FLEXK,CAPS,CAP,CAPT,CAPN,SPALS,CAPXC,CICRR,CAPZ,CAPHC,C,
2 MAXR,ATIT,CZRE,CNIN,HR,HADD,NSTRF,ACPT,DELY,ZI,MAXC,AC,
3 CNRC,A,B,C,G,EIGVAL,NITER,DIVQ,EP,IR,1

600 FORMAT (1H1 3BX, 17D-DIVERGENCE CPTICN // 1HC 16X, 4HMCDE 1CX,HP32C50
1 6HLAMBOA 11X, 11HDIVERGENT 0 7X, 14HNO. ITERATIONS // ) HP32C51
601 FORMAT (1H 1119, 2E20.8, 1113 ) HP32C52
602 FORMAT (1H 43X, 26HIMAGINARY RESULT FROM MCDE 114 ) HP32C53
603 FORMAT (1H 22X, 4CHINSUFFICIENT CONVERGENCE AFTER 200 ITERA
1 11HTIONS, MCDE 114 ) HP32C54
604 FORMAT (1H0 37X, 4CHMEDAL CELLPNS NORMALIZED ON THE LARGEST
1 RHELEMENT ) HP32C55
605 FORMAT (48H0 AN OVERFLOW OCCURED IN THE EIGENVALUE ROUTINE.
1 111G, 19H- MODES ARE CORRECT. ) HP32C56
606 FORMAT ( 1H0 25X,36H CHECK EIGENVALUES AND EIGENVECTORS ) HP32C57

WRITE CLTPUT TAPE NTAPE3, 60C HP32C58
REWIND NTAPE4 HP32C59
REWIND NTAPE5 HP32C60

C READ FLEXIBILITY MATRIX INTO CORE AT C, AND AERCDYNAMIC MATRIX AT B
READ TAPE NTAPE4, ((C(I,J),J=1,NRC),I=1,NRC) HP32C61
READ TAPE NTAPE5, ((B(I,J),J=1,NRC),I=1,NRC) HP32C62
CALL PMULTD (C,C,B,J,A,NRC,NRC,NRC,MAXR,MAXR,MAXR) HP32C63

```

11/12/62

C SET UP GLESS EIGENVECTOR FOR ITERATION.

```

CG 61C I=1,NRC
610 G(I)=1

      EP=.2E-05
      CALL MITER (A,NTAPEE,NRC,G,1,NMCDE,8,EIGVAL,NITER,200,EP,IN,C,
1      C(1,26),MAXR,1,.98C832,LL,C)
      IF ( IR ) 611,612,611
611 IR=IR-1
      WRITE CUPUT TAPE NTAPE3, 605, IR
      NMCDE=IR

612 CO 616 I=1,NMCDE
      CIVQ=CBAR/(EIGVAL(I)*FLEXK*CAPS)
      IF (EIGVAL(I)) 613,613,614

613 WRITE CUPUT TAPE NTAPE3, 602, I
614 IF ( NITER(I)-199) 616,616,615

615 WRITE CUPUT TAPE NTAPE3, 603, I
616 WRITE CUPUT TAPE NTAPE3, 601, I, EIGVAL(I), DIVQ, NITER(I)

      WRITE CUPUT TAPE NTAPE3, 604
      CALL MPRINT (B,NRC,NMCDE,MAXR,NTAPE3)
      WRITE CUPUT TAPE NTAPE3, 606
      CALL MPRINT (C(1,26),NMCDE,1,MAXR,NTAPE3)
      CALL MPRINT (C,NRC,NMCDE,MAXR,NTAPE3)

      RETURN
      END(1,0,0,0,0,0,0,0,1,0,0,0,0,0)

```

\* DATA

HM032102

UNCLASSIFIED	<p>Aerospace Corporation, El Segundo, California. QUASI-STATIC AERO-THERMO-ELASTIC ANALYSIS: ANALYTICAL DEVELOPMENT AND COMPUTATIONAL PROCEDURE, prepared by W. P. Rodden, E. F. Farkas, and H. A. Malcom. 1 March 1963. [172] p. incl. illus. (Report TDR-169(3230-11)TN-8; SSD-TDR-63-14) (Contract AF 04(695)-169). Unclassified report</p> <p>A collocation formulation is used as the basis for a unified approach to the various quasi-static aero-thermo-elastic problems. These problems include rigid and flexible load distributions, divergence, estimation of rigid and flexible static and dynamic stability derivatives, and the correction of wind tunnel data measured on flexible models. The formulation utilizes structural, thermal, and aerodynamic influence coefficients. The Aerospace IBM 7090 Computer Program No. LD003A provides the solution to the above problems. The program (over)</p>
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